Training on Frames

Structure & Reinforcement

Example.

نسألكم الدعاء

95 kN 170 kN 170 kN 95 kN

20 kN\m

100 kN 100 kN 100 kN 100 kN

15 kN\m 15 kN\m

2.0

3.5

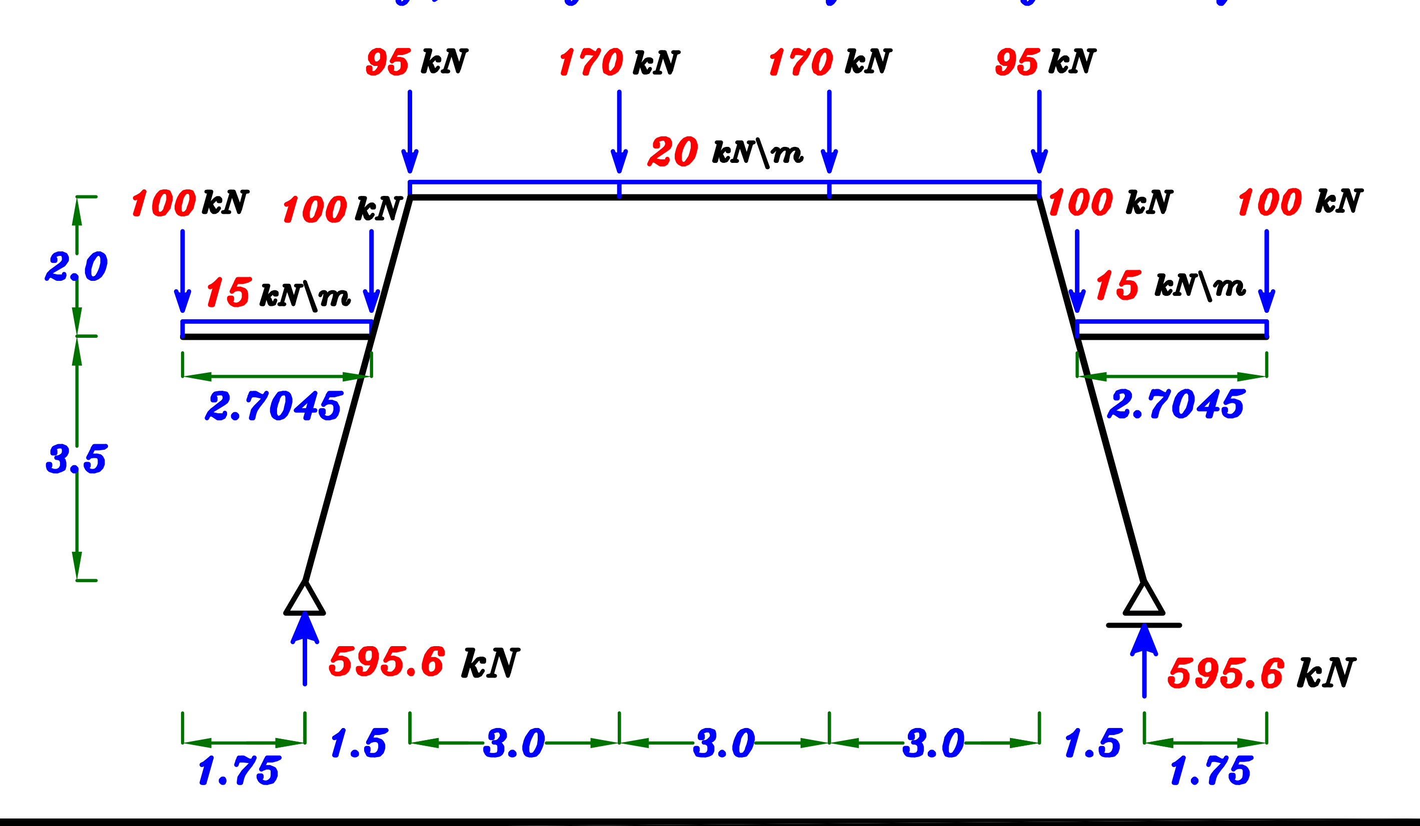
2.7045 2.7045

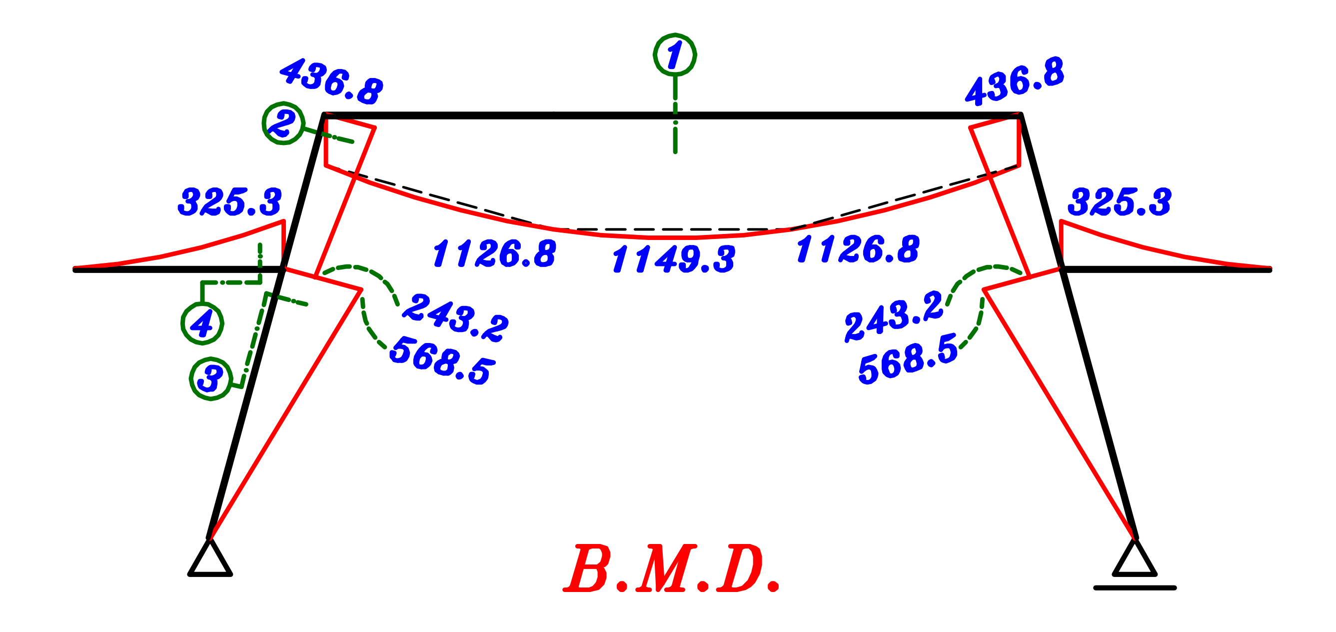
1.75 1.5 3.0 3.0 3.0 1.5 1.75

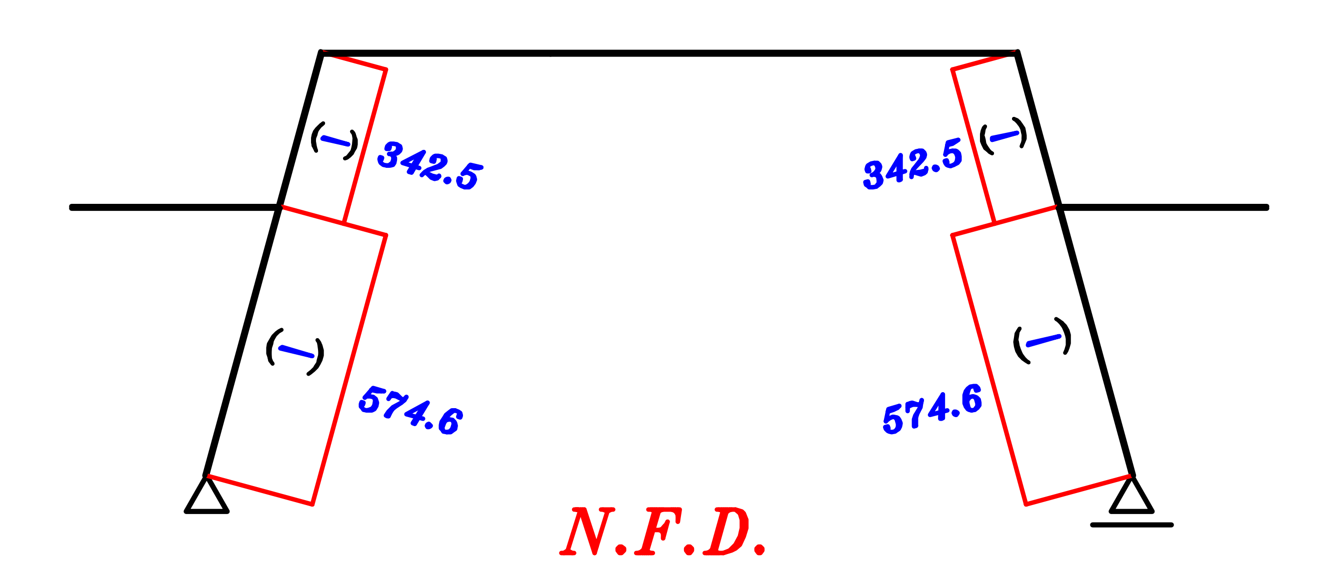
① Calculate the Reactions & Draw Internal Forces Diagrams.

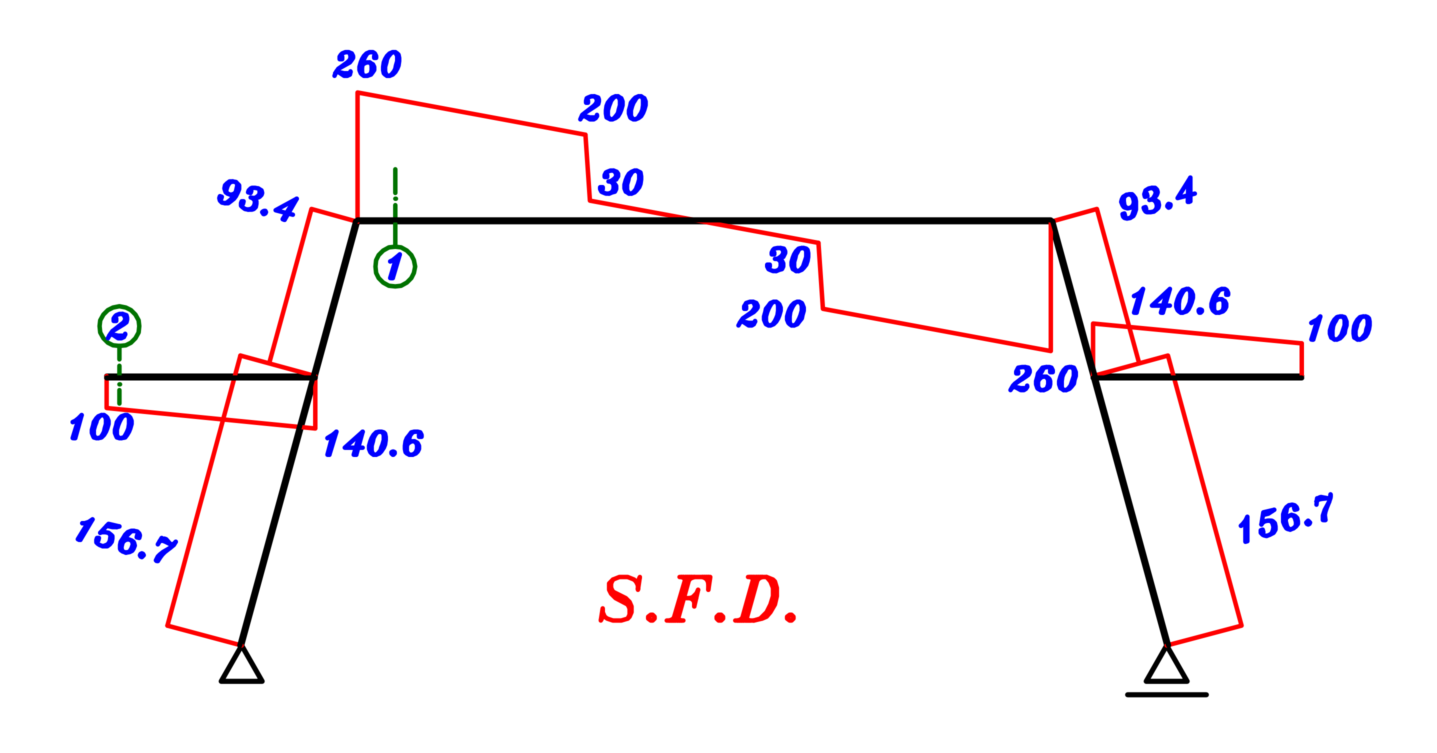
② Determine the critical sections in Bending & Shear For the Frame.

③ Draw Main RFT. only , making curtailment of steel using Moment of Resistance.




436.8
1
436.8
2
325.3
325.3
1126.8
1149.3
1126.8
4
243.2
243.2
568.5
568.5
3
B.M.D.


(−)
342.5
342.5
(−)
(−)
(−)
574.6
574.6
N.F.D.

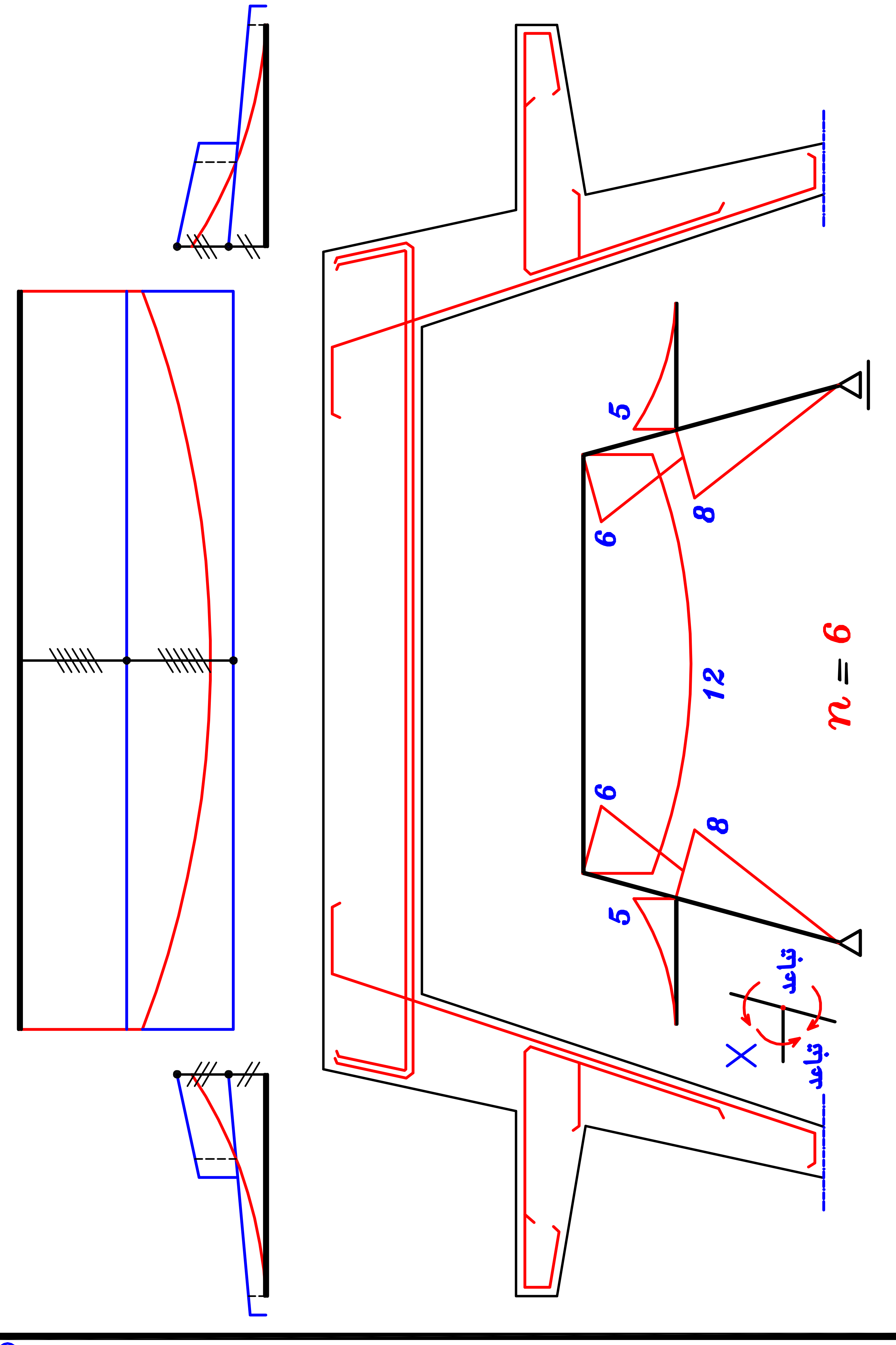

260
200
30
93.4
93.4
1
30
2
200
140.6
100
100
260
140.6
156.7
156.7
S.F.D.

③ Draw Main RFT. & Blocks of moment of Resistance.

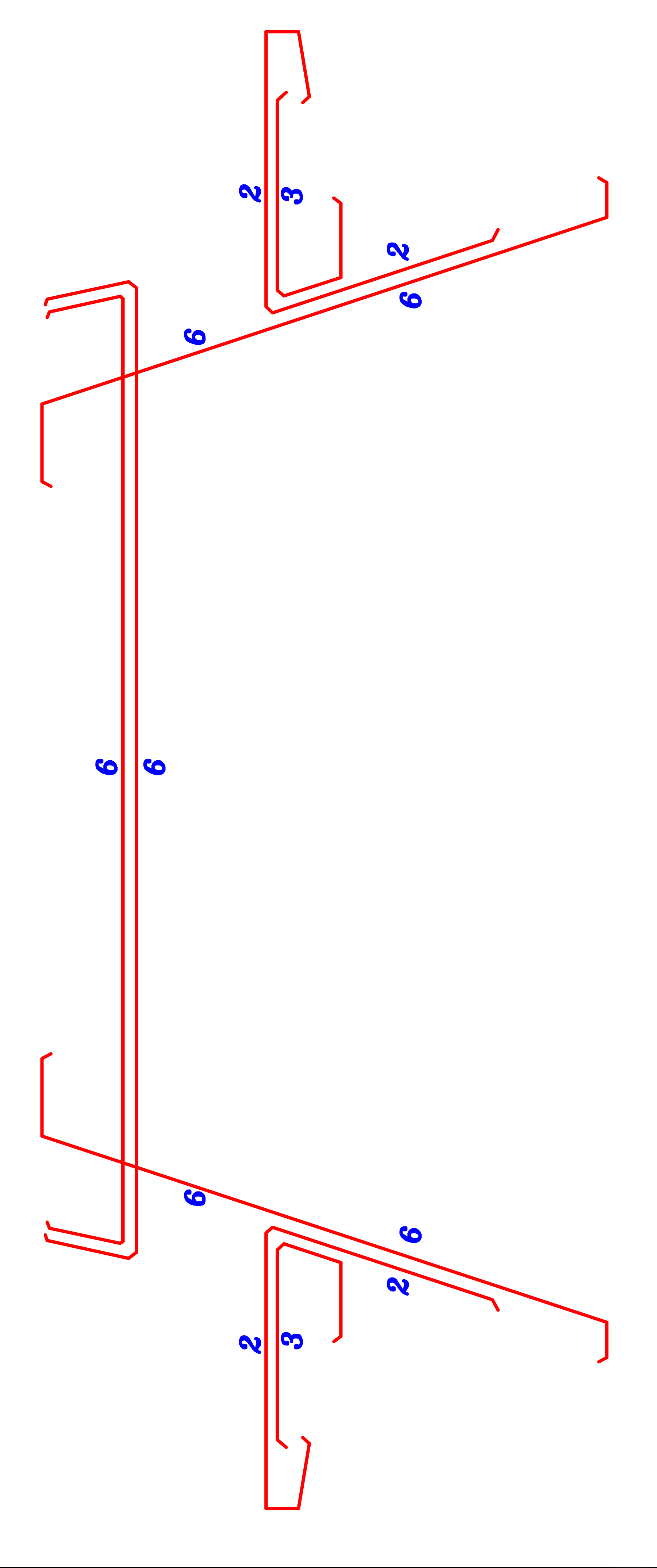
5 6 6 5

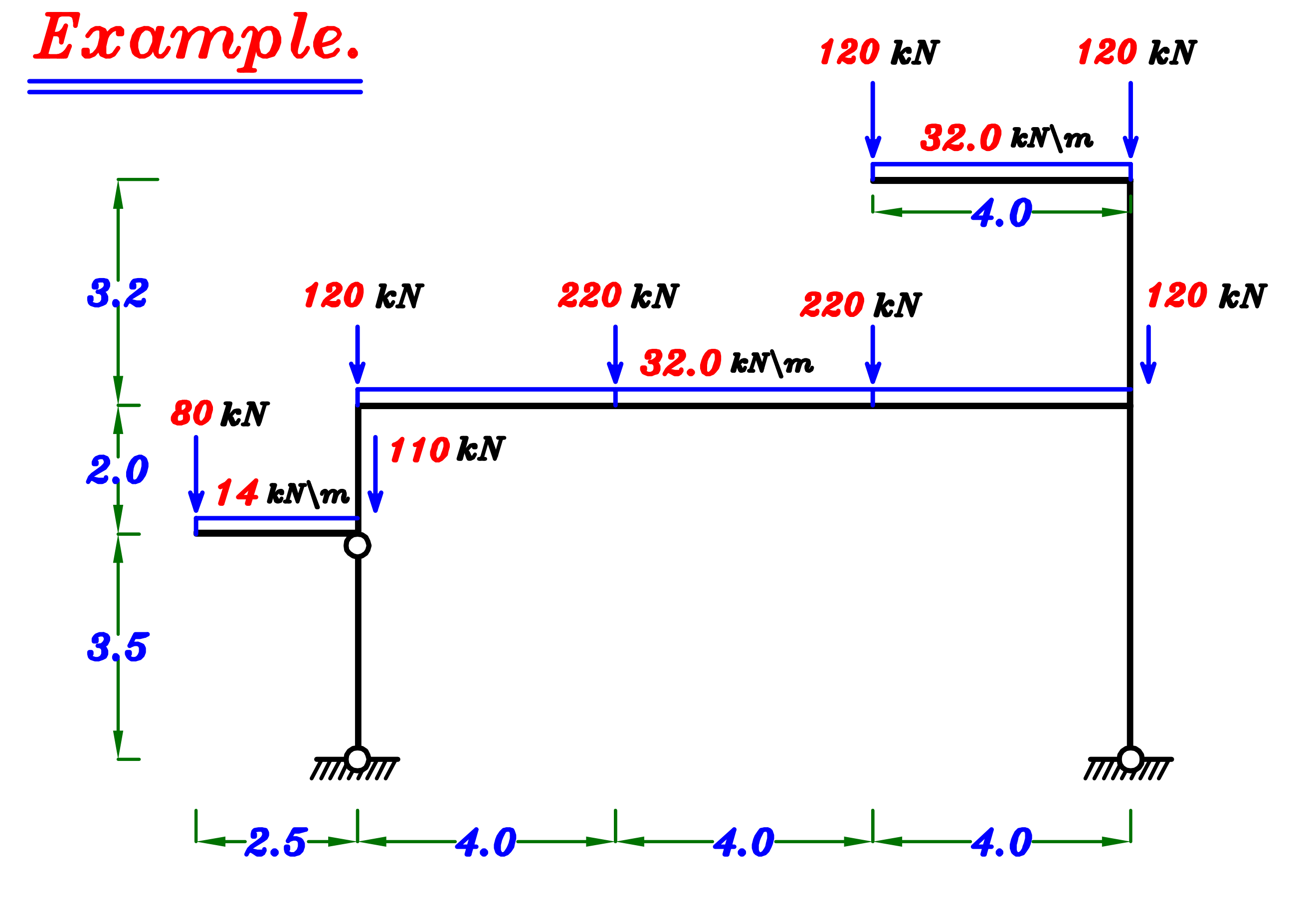
8 12 8

$n = 6$



5
6
8
12
$n = 6$
6
8
5
تباعد
تباعد


2
3
2
6
6
6
6
6
6
2
2
3

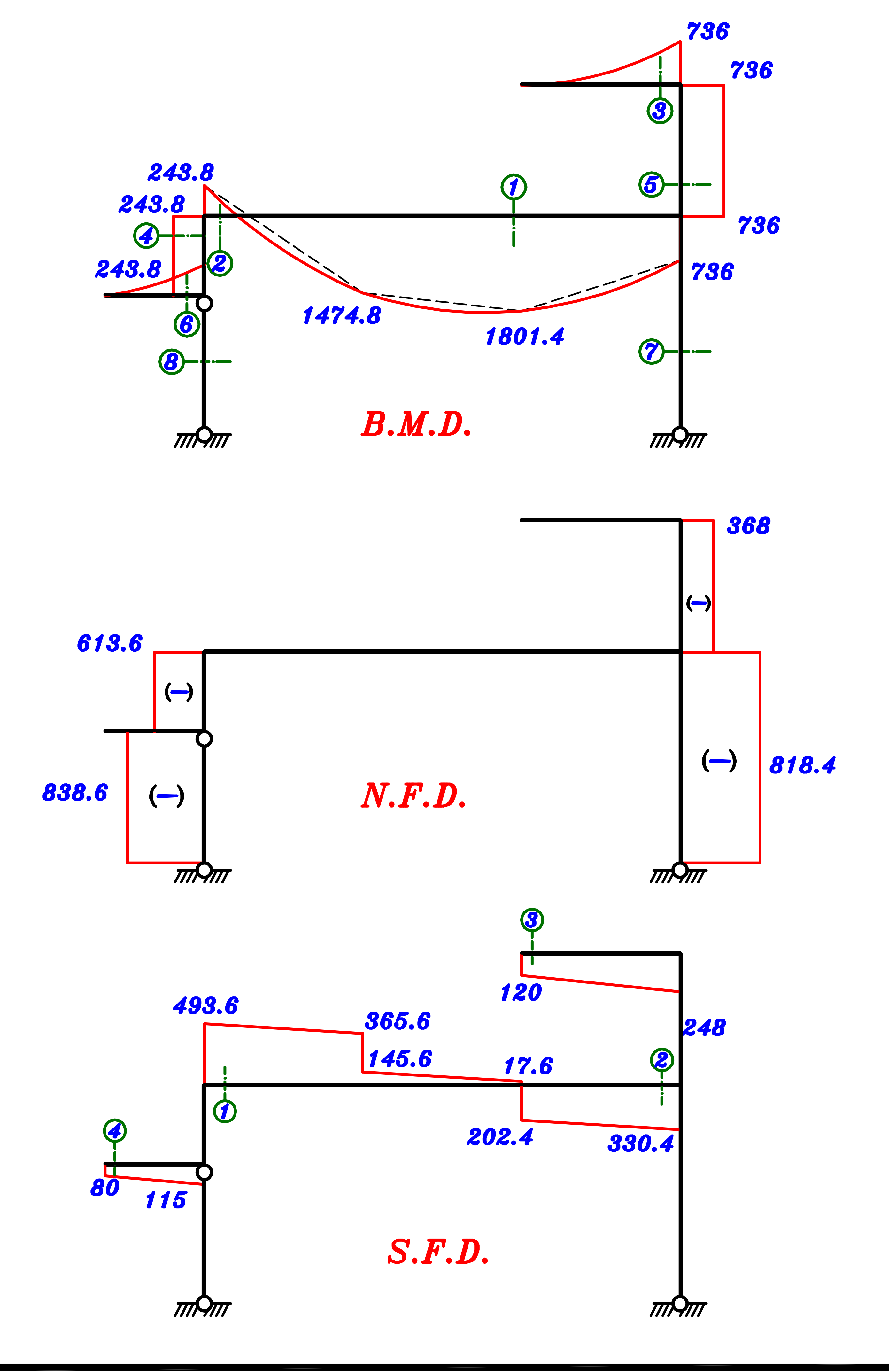


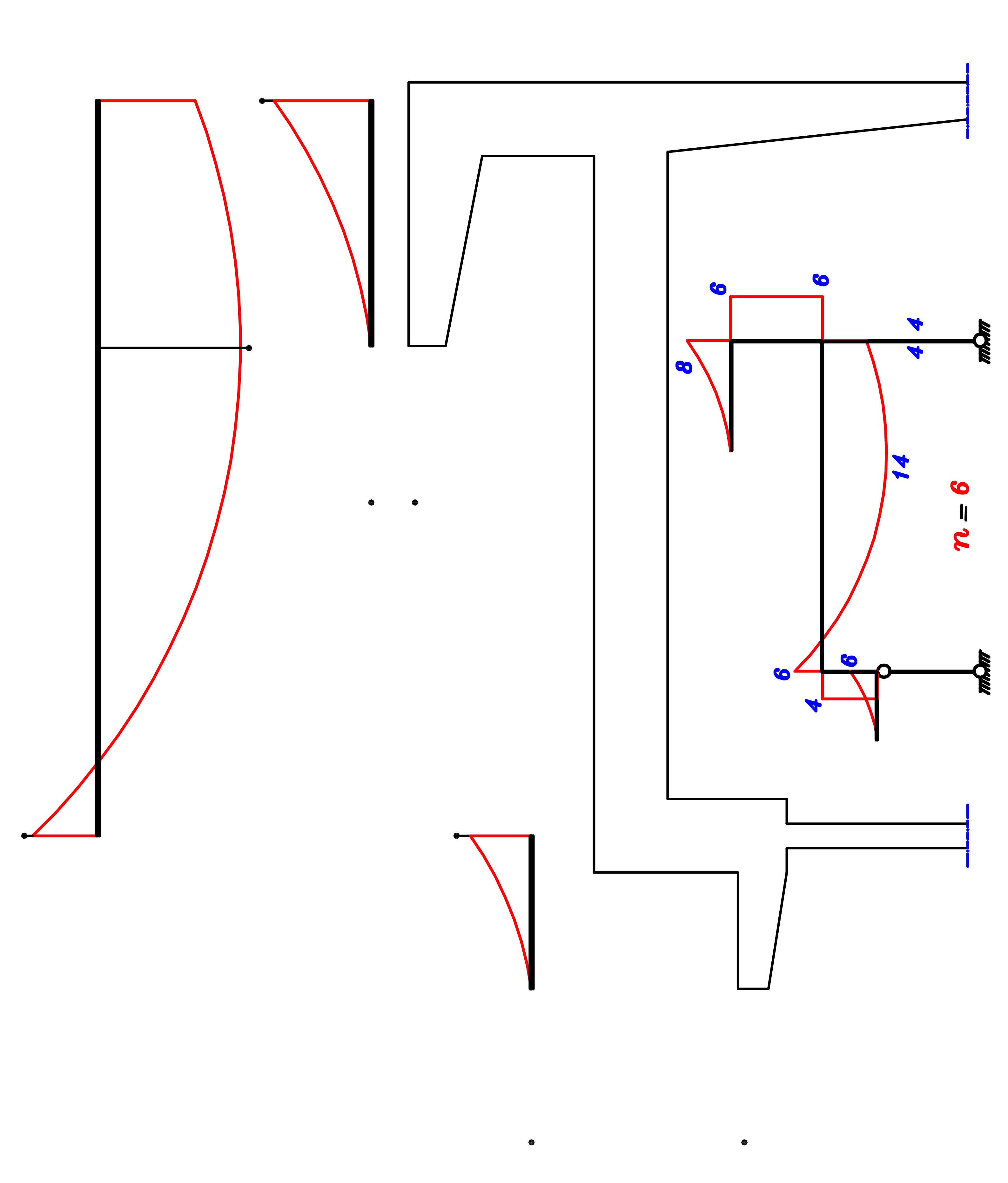
① Calculate the Reactions & Draw Internal Forces Diagrams.

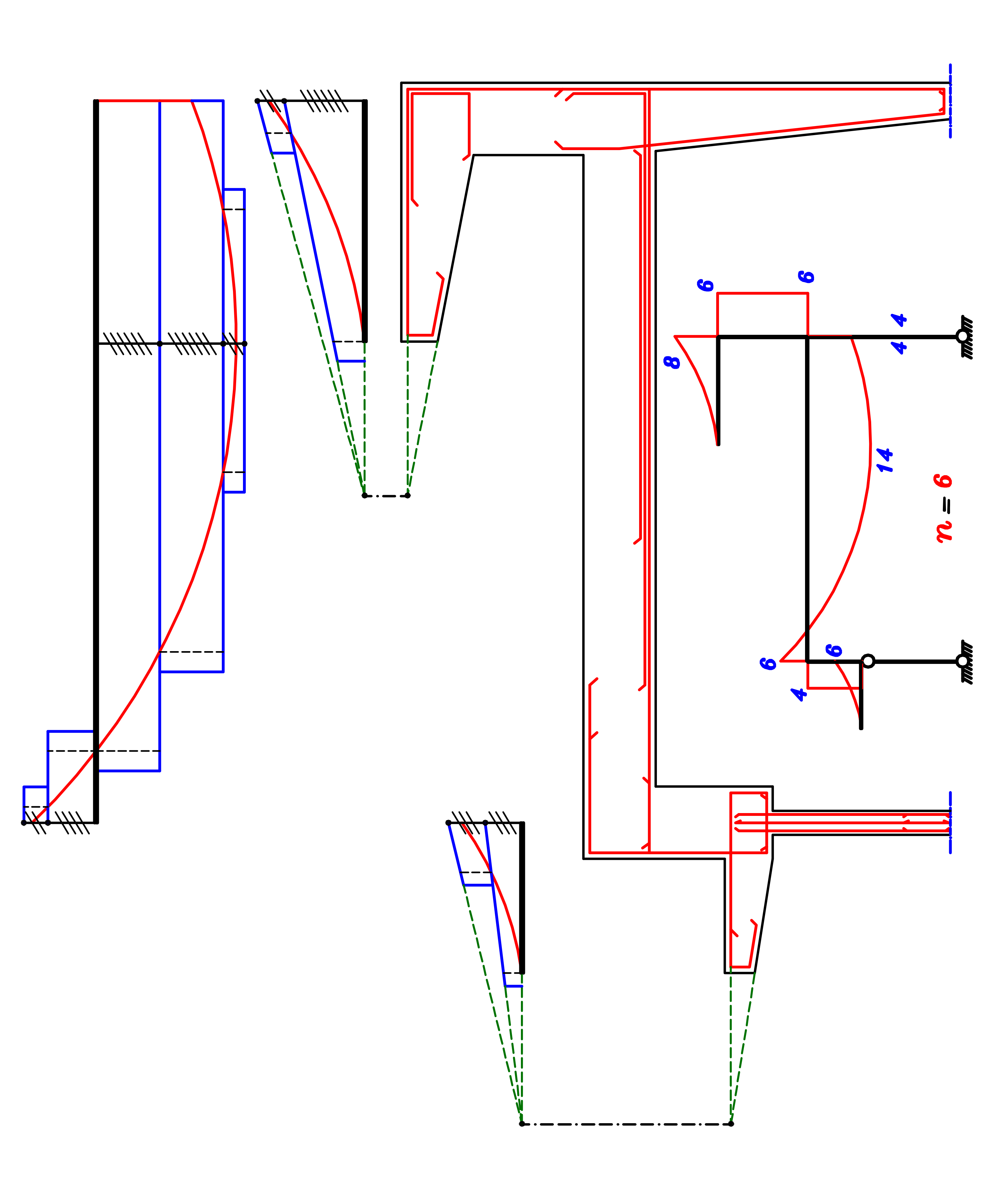
② Determine the critical sections in Bending & Shear For the Frame.

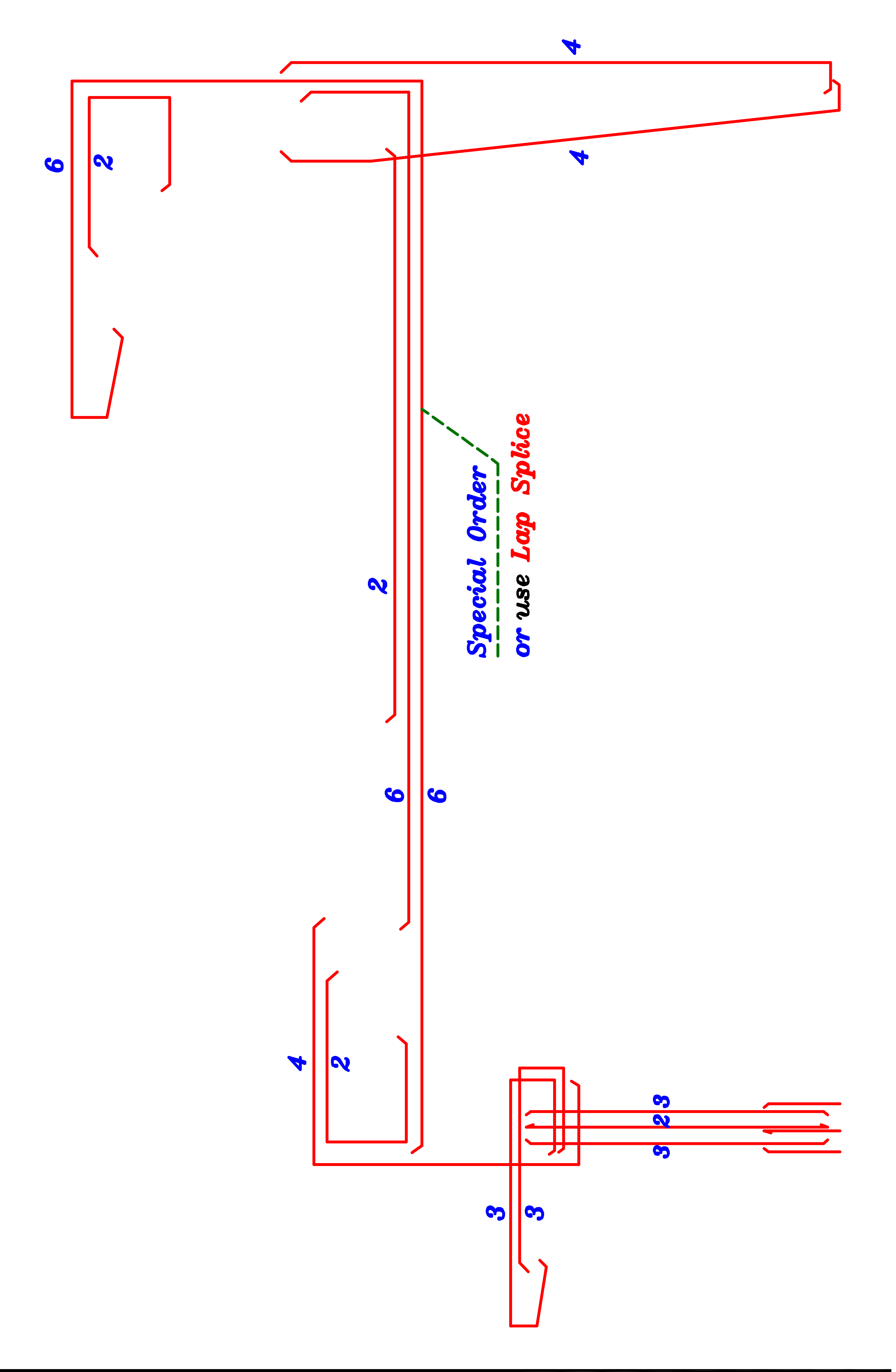
③ Draw Main RFT. only , making curtailment of steel using Moment of Resistance.

120 kN
120 kN
32.0 kN\m
4.0
3.2
120 kN
220 kN
220 kN
120 kN
32.0 kN\m
80 kN
110 kN
2.0
14 kN\m
3.5
838.6 kN
818.4 kN
2.5
4.0
4.0
4.0


736
736
736
736
243.8
243.8
243.8
1474.8
1801.4
B.M.D.
368
613.6
(–)
(–)
838.6
(–)
818.4
N.F.D.
493.6
365.6
145.6
120
248
17.6
202.4
330.4
80
115
S.F.D.


6
6
8
4
4
14
n = 6
6
6
4


6
6
4
4
8
14
n = 6
6
6
4


4
4
6
2
2
6
6
Special Order
or use Lap Splice
4
2
3 2 3
3
3

Example.

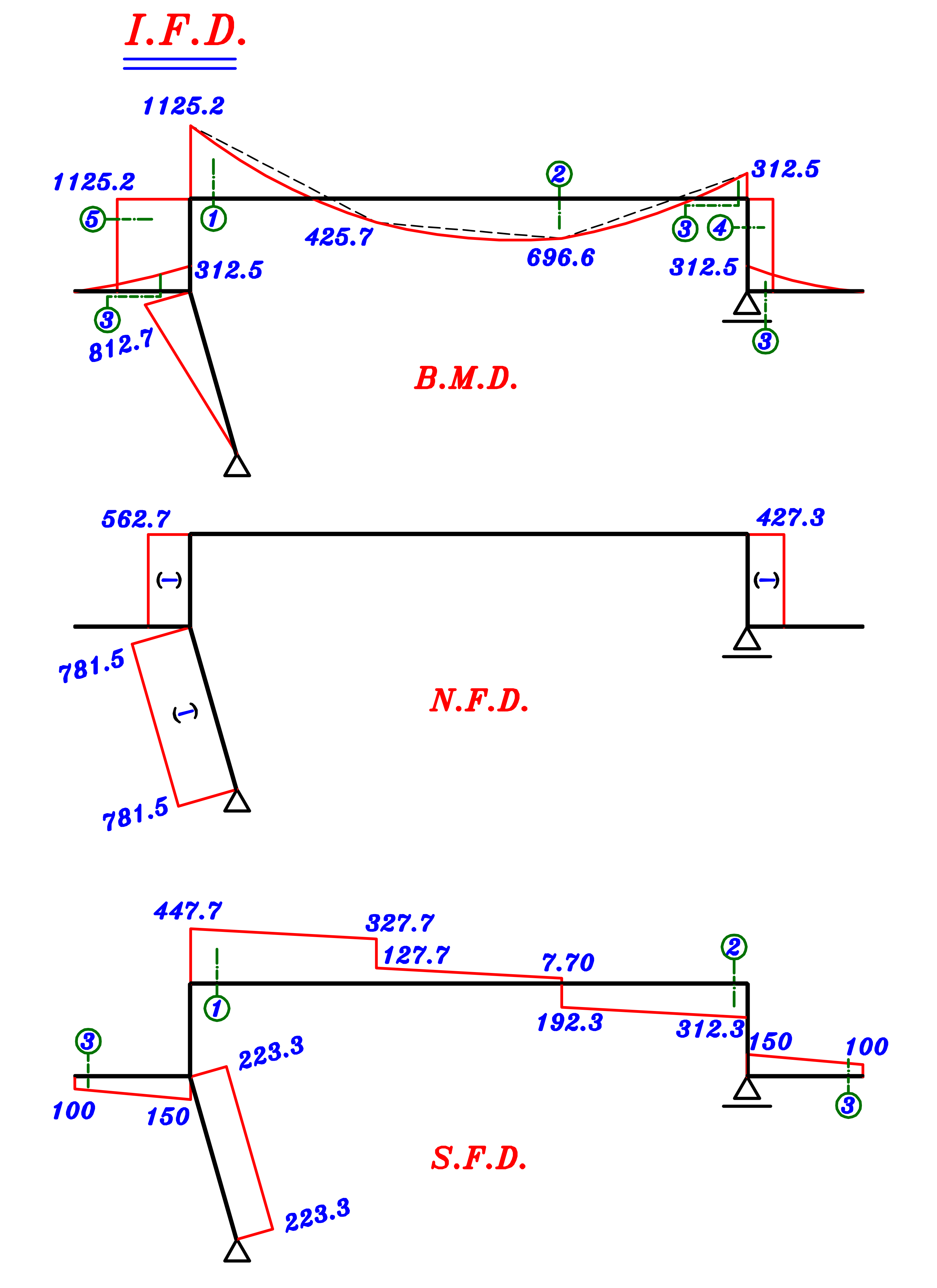
115 kN   200 kN   200 kN   115 kN
30 kN\m
100kN   100kN   100kN   100kN
20 kN\m   20 kN\m
2.0   3.5
4.0   4.0   4.0
2.5   1.0   11.0   2.5

① Calculate the Reactions & Draw Internal Forces Diagrams.

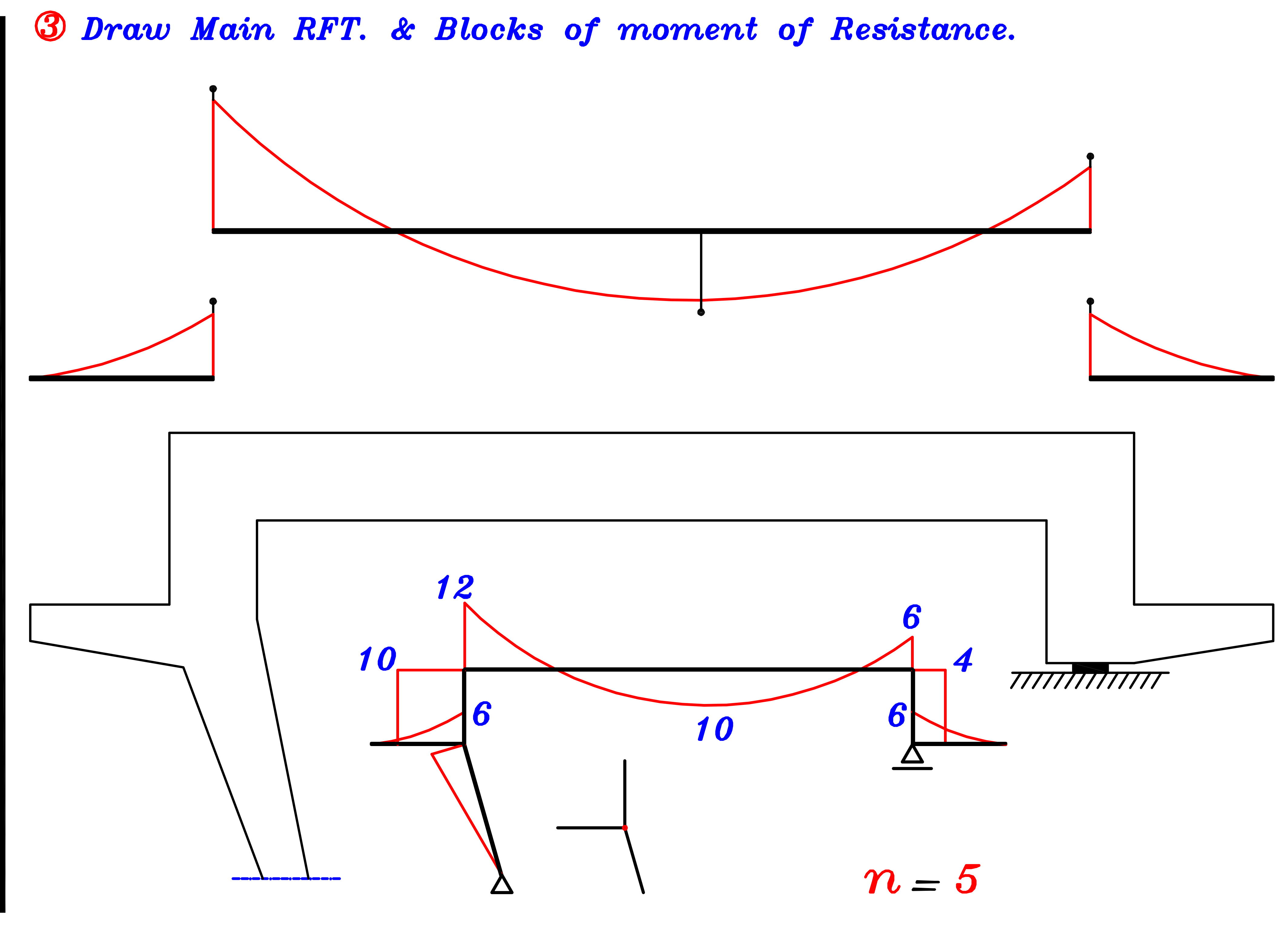
② Determine the critical sections in Bending & Shear For the Frame.

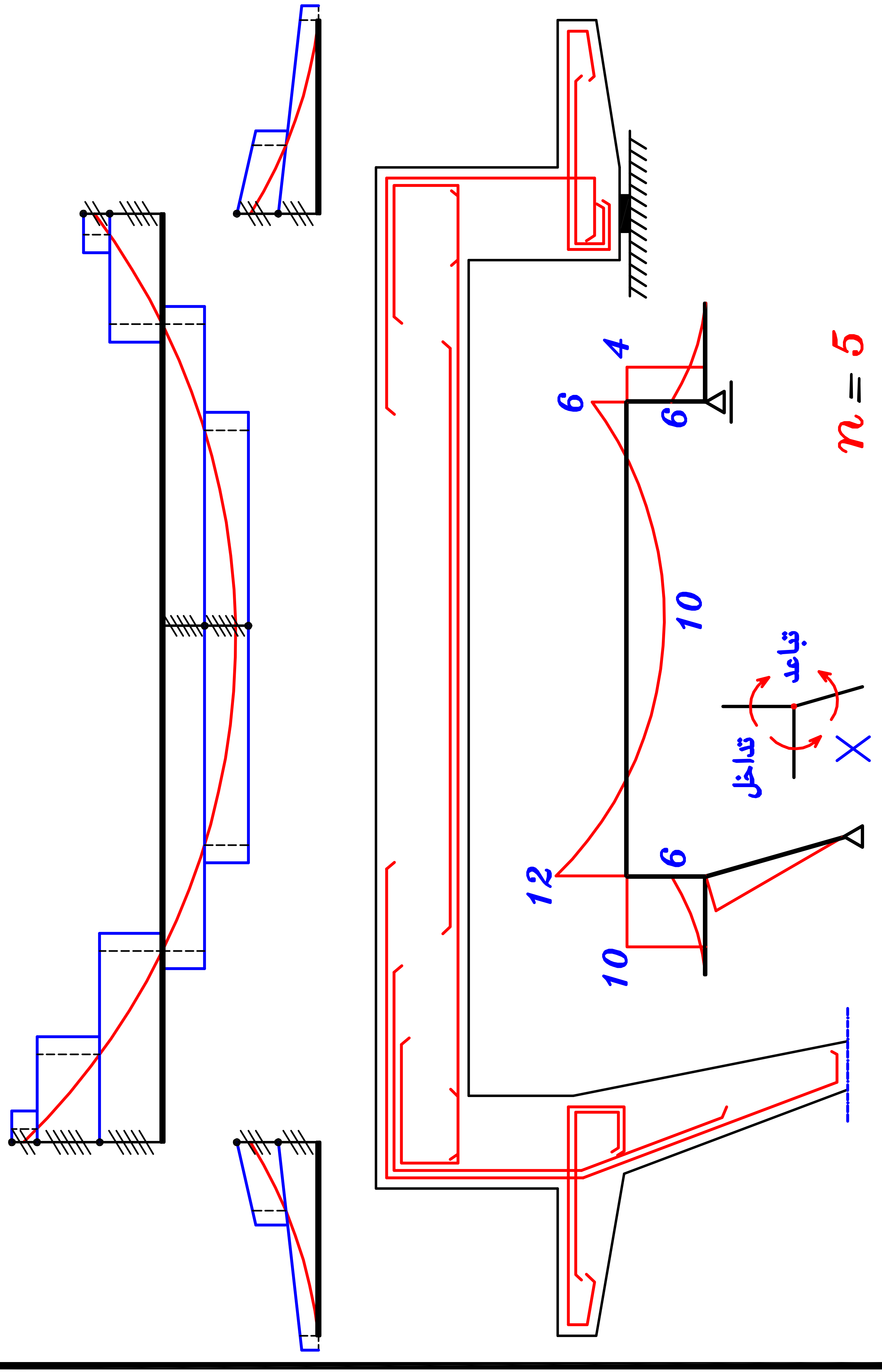
③ Draw Main RFT. only , making curtailment of steel using Moment of Resistance.

115 kN   200 kN   200 kN   115 kN
30 kN\m
100kN   100kN   100kN   100kN
20 kN\m   20 kN\m
2.0   3.5
4.0   4.0   4.0
677.3 kN
812.7 kN
2.5   1.0   11.0   2.5

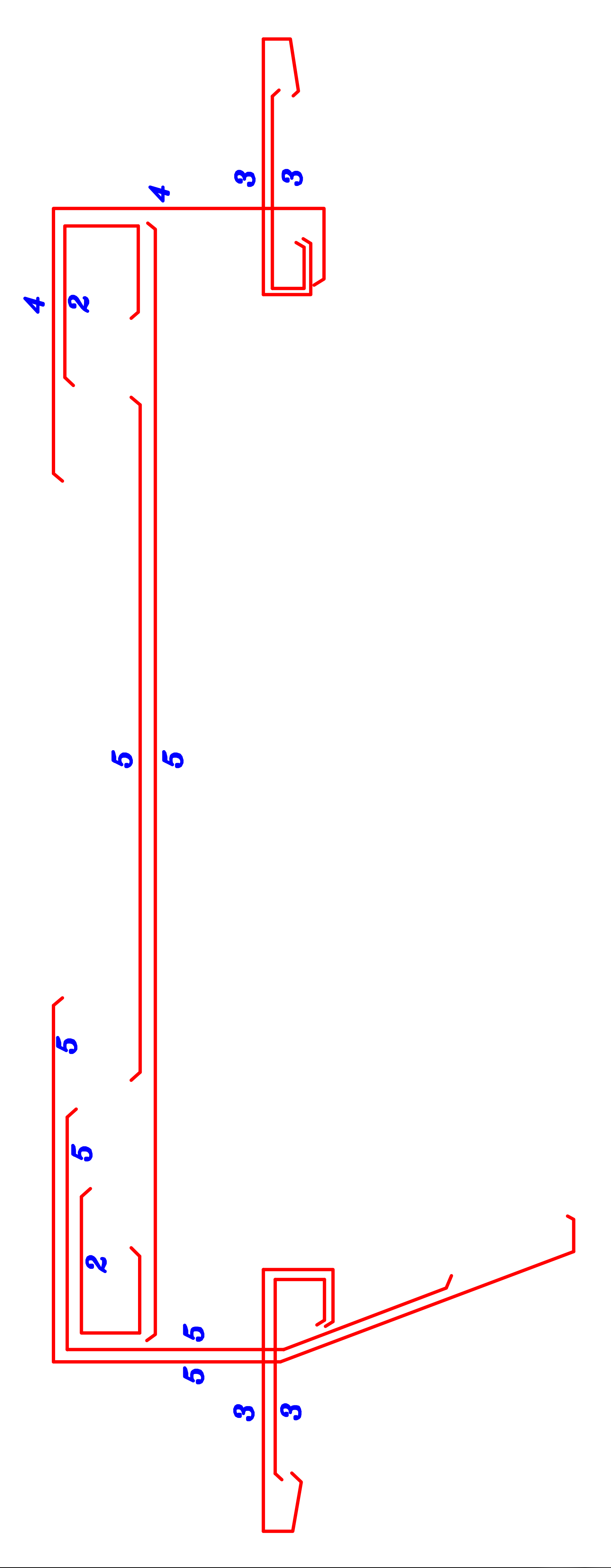

I.F.D.
1125.2
1125.2
312.5
425.7
696.6
312.5
312.5
812.7
B.M.D.
562.7
427.3
(−)
(−)
781.5
(−)
781.5
N.F.D.
447.7
327.7
127.7
7.70
192.3
312.3
150
100
223.3
100
150
223.3
S.F.D.

③ Draw Main RFT. & Blocks of moment of Resistance.



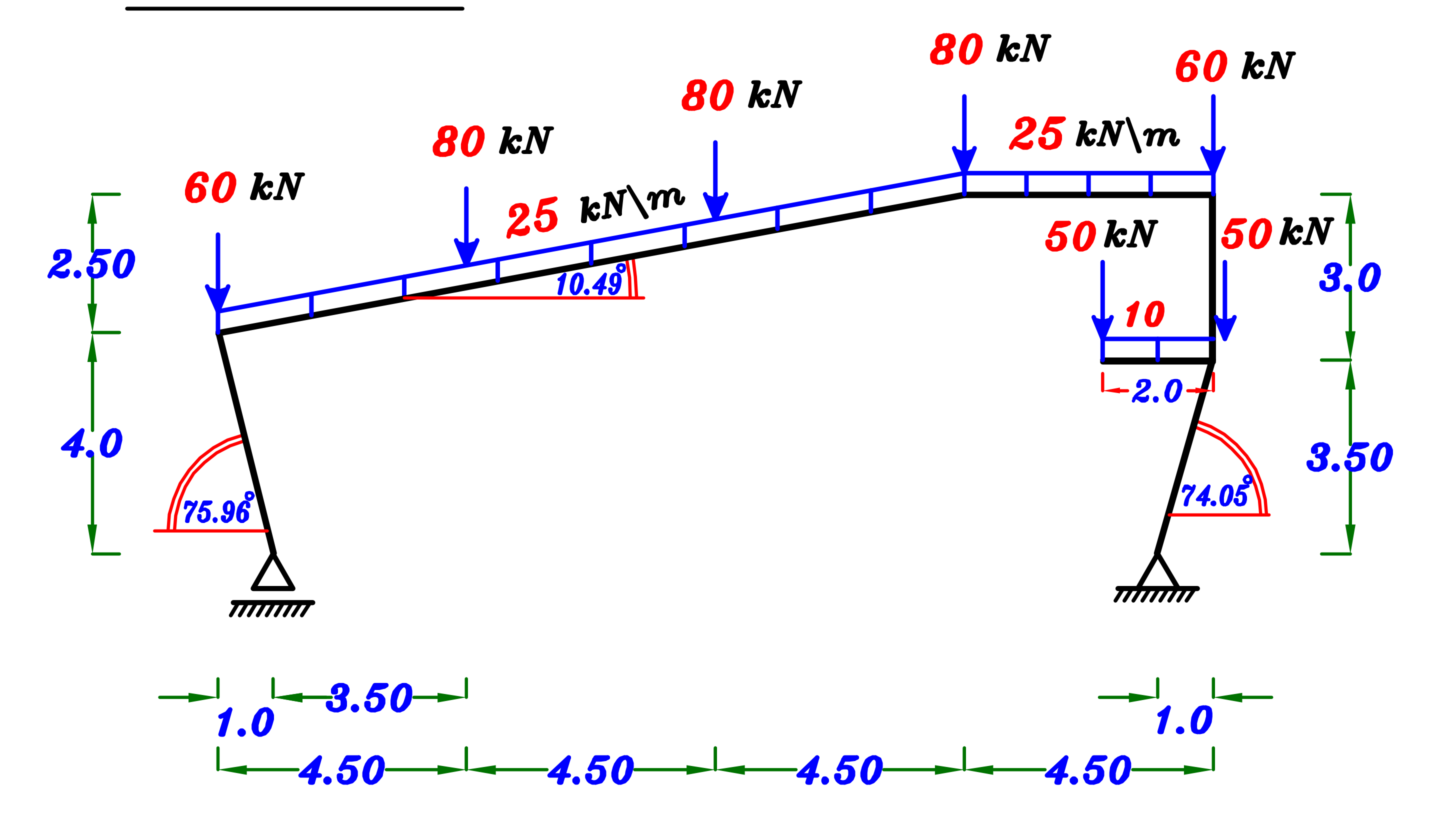


n = 5
4
6
6
10
6
12
10
تباعد
تداخل



3
3
4
4
2
5
5
5
5
2
5
5
3
3

Example.



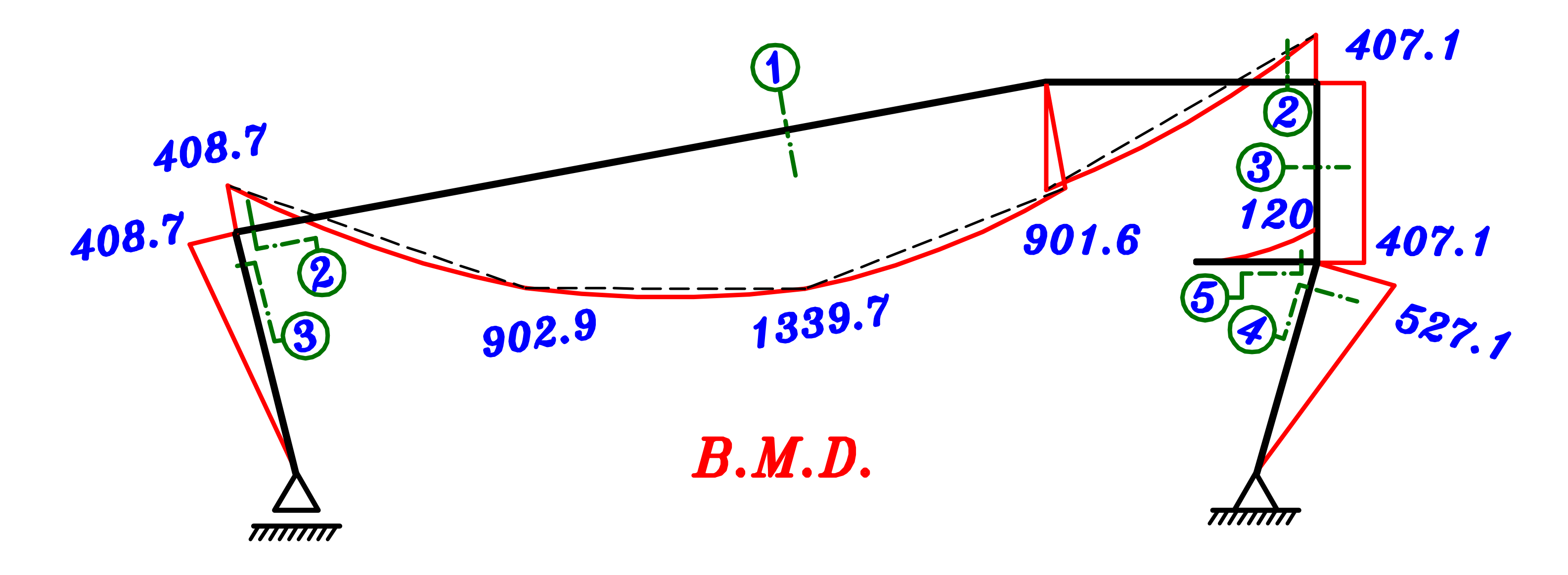
① Calculate the Reactions & Draw Internal Forces Diagrams.

② Determine the critical sections in Bending & Shear For the Frame.

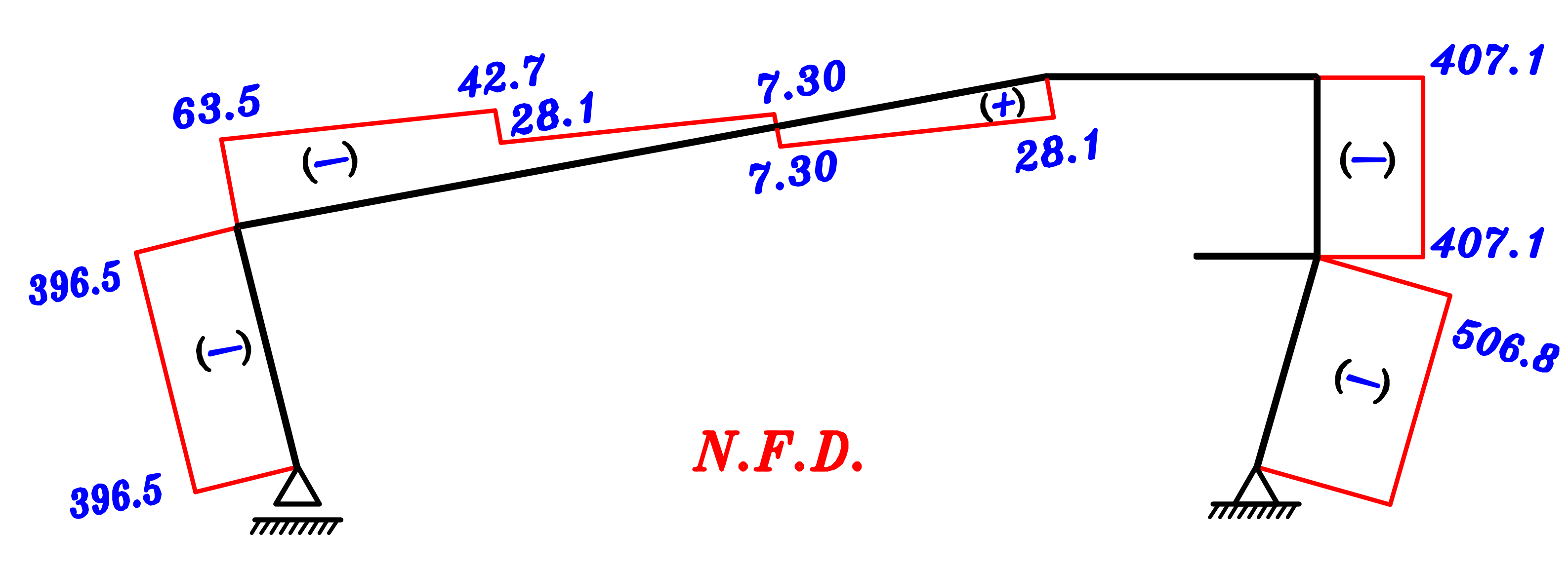
③ Draw Main RFT. only , making curtailment of steel using Moment of Resistance.

13.73
4.57
4.57
4.57
60 kN
80 kN
80 kN
80 kN
60 kN
25 kN\m
25 kN\m
50 kN
50 kN
10
2.0
10.49°
75.96°
74.05°
2.50
4.0
3.0
3.50
408.7 kN
527.1 kN
1.0
3.50
1.0
4.50
4.50
4.50
4.50

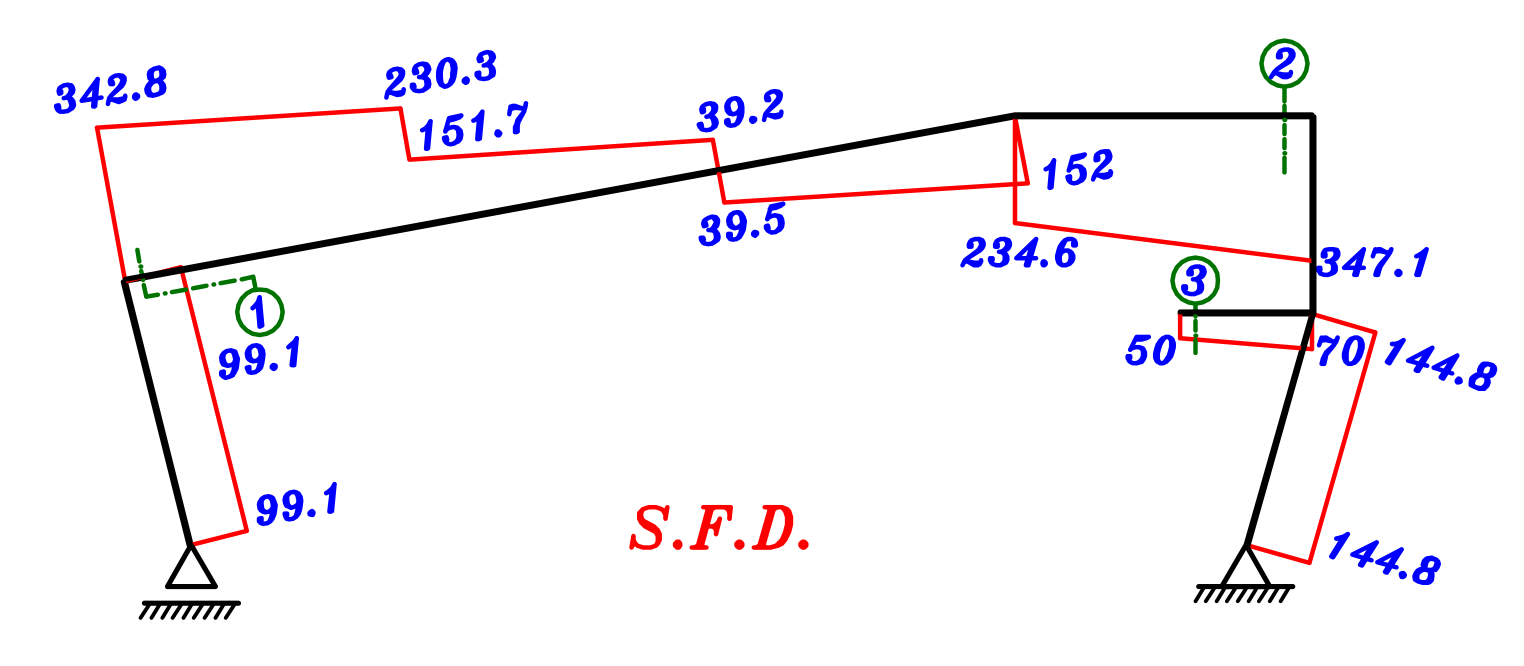
I.F.D.



408.7
408.7
1
2
3
902.9
1339.7
901.6
407.1
2
3
120
407.1
5
4
527.1
B.M.D.

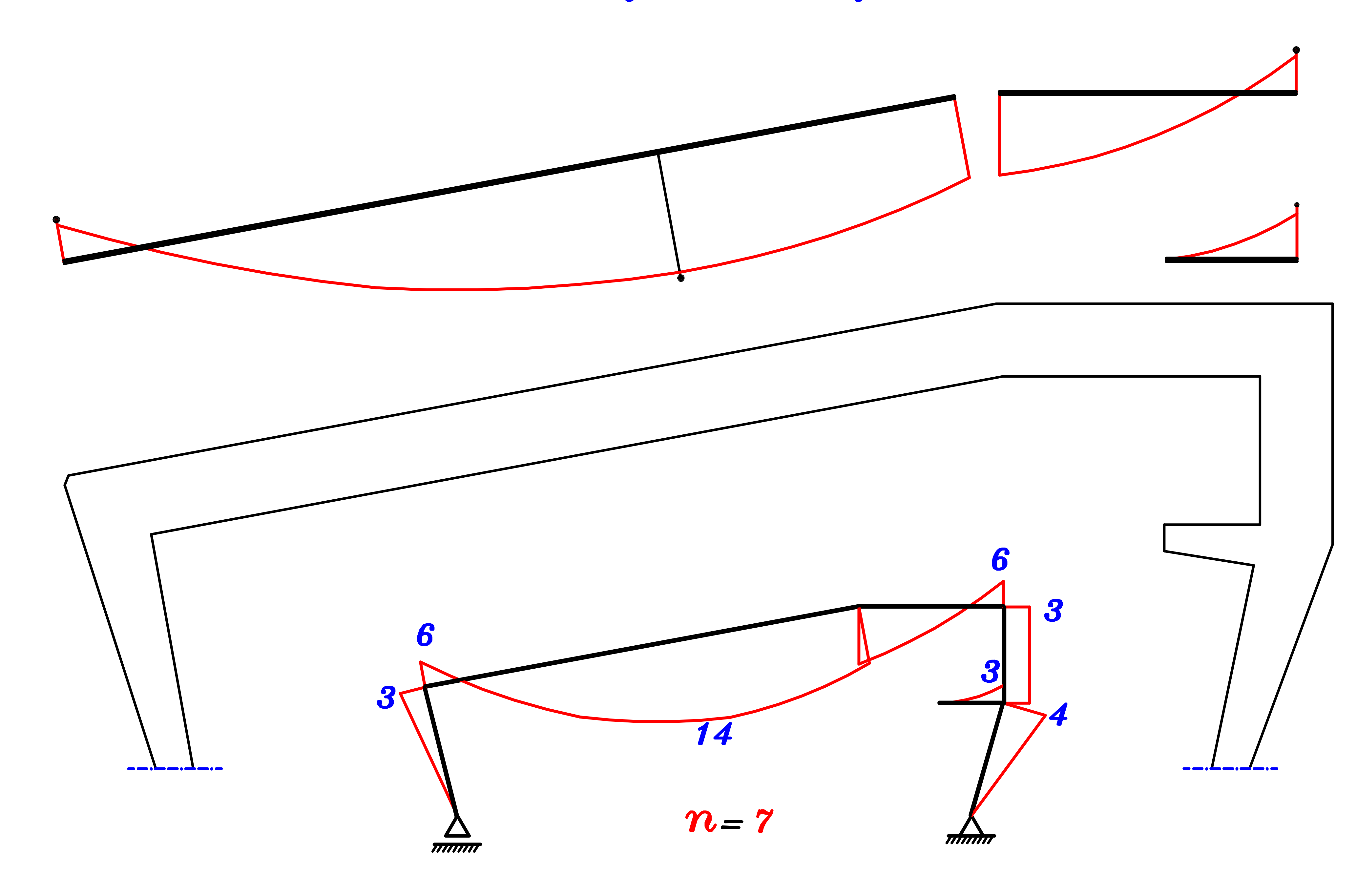


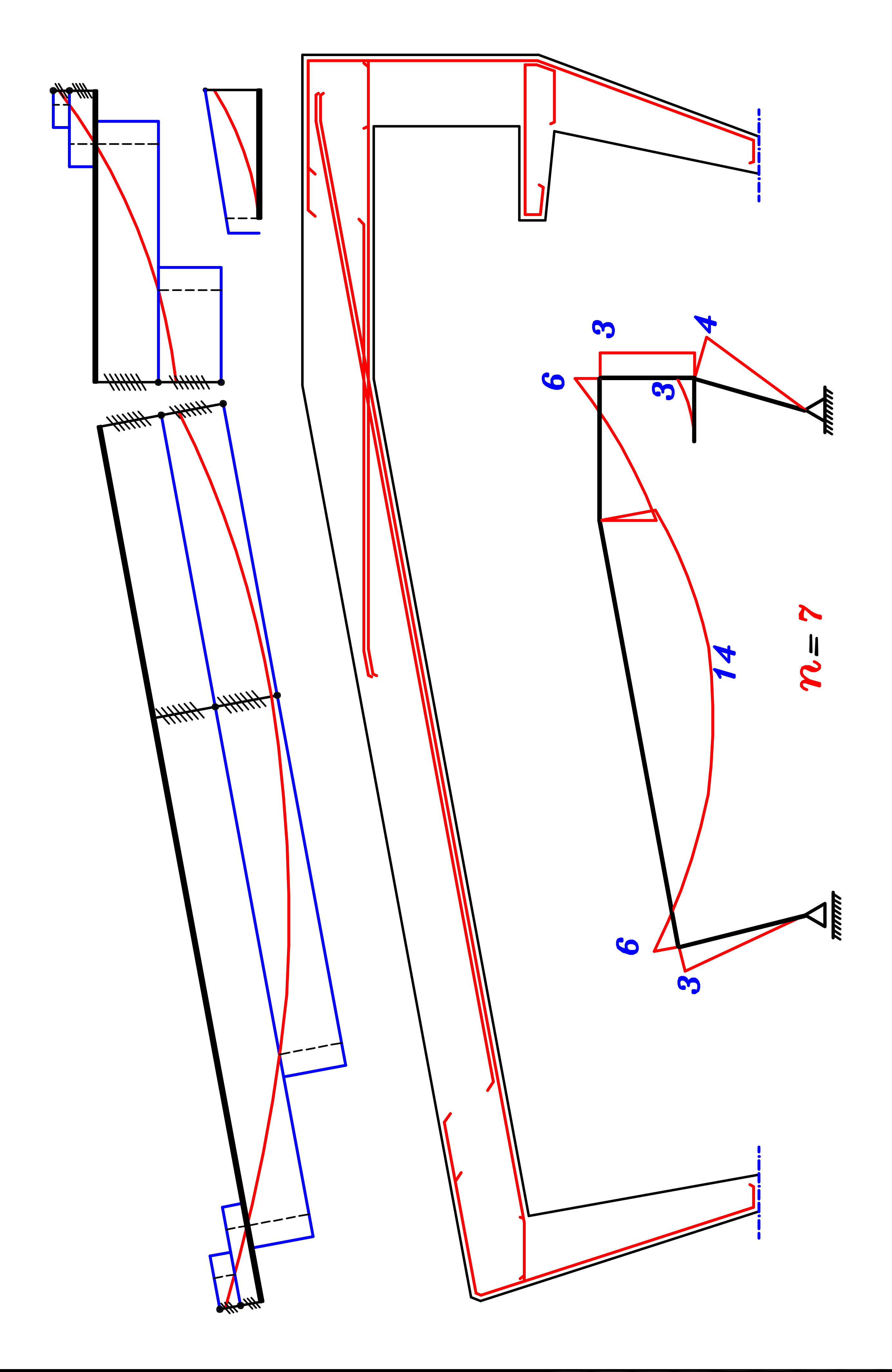
63.5
42.7
28.1
7.30
(+)
(–)
7.30
28.1
407.1
(–)
407.1
396.5
(–)
506.8
(–)
396.5
N.F.D.

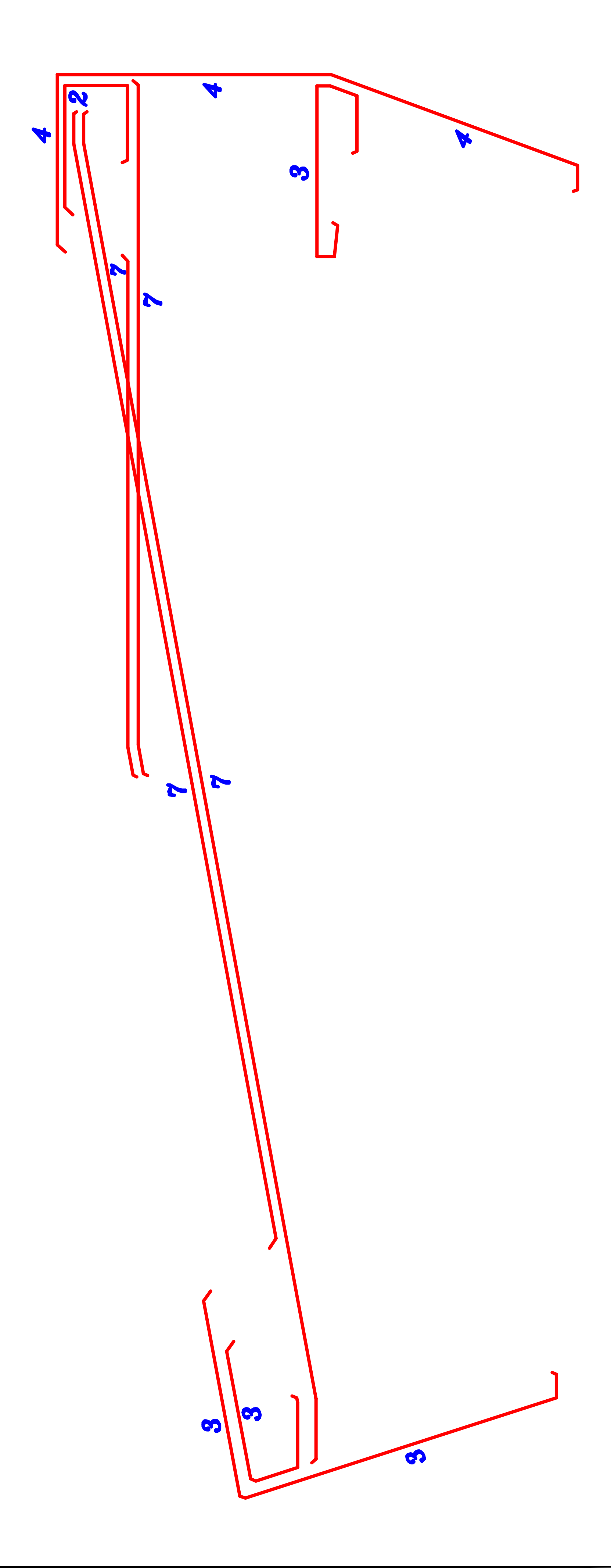


342.8
230.3
151.7
39.2
2
152
39.5
234.6
347.1
3
1
99.1
50
70
144.8
99.1
S.F.D.
144.8

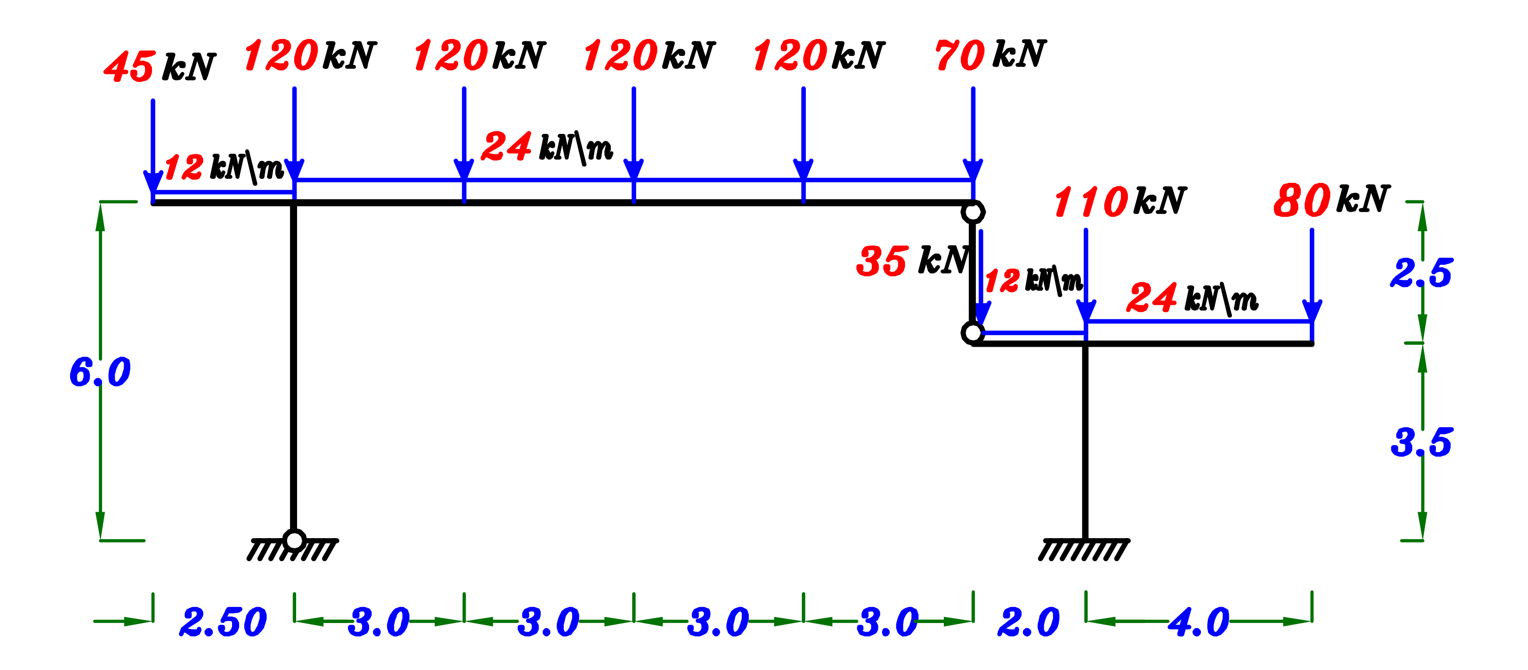
③ Draw Main RFT. & Blocks of moment of Resistance.




3
4
6
3
14
6
3
n = 7


4
2
4
4
3
7
7
7
7
3
3
3

Example.



① Calculate the Reactions & Draw Internal Forces Diagrams.

② Determine the critical sections in Bending & Shear For the Frame.

③ Draw Main RFT. only , making curtailment of steel using Moment of Resistance.

45 kN 120 kN 120 kN 120 kN 120 kN 70 kN

12 kN\m 24 kN\m

6.0

381.5 kN

531.5 kN

2.50 3.0 3.0 3.0 3.0

110 kN 80 kN

35 kN 12 kN\m 24 kN\m

2.5

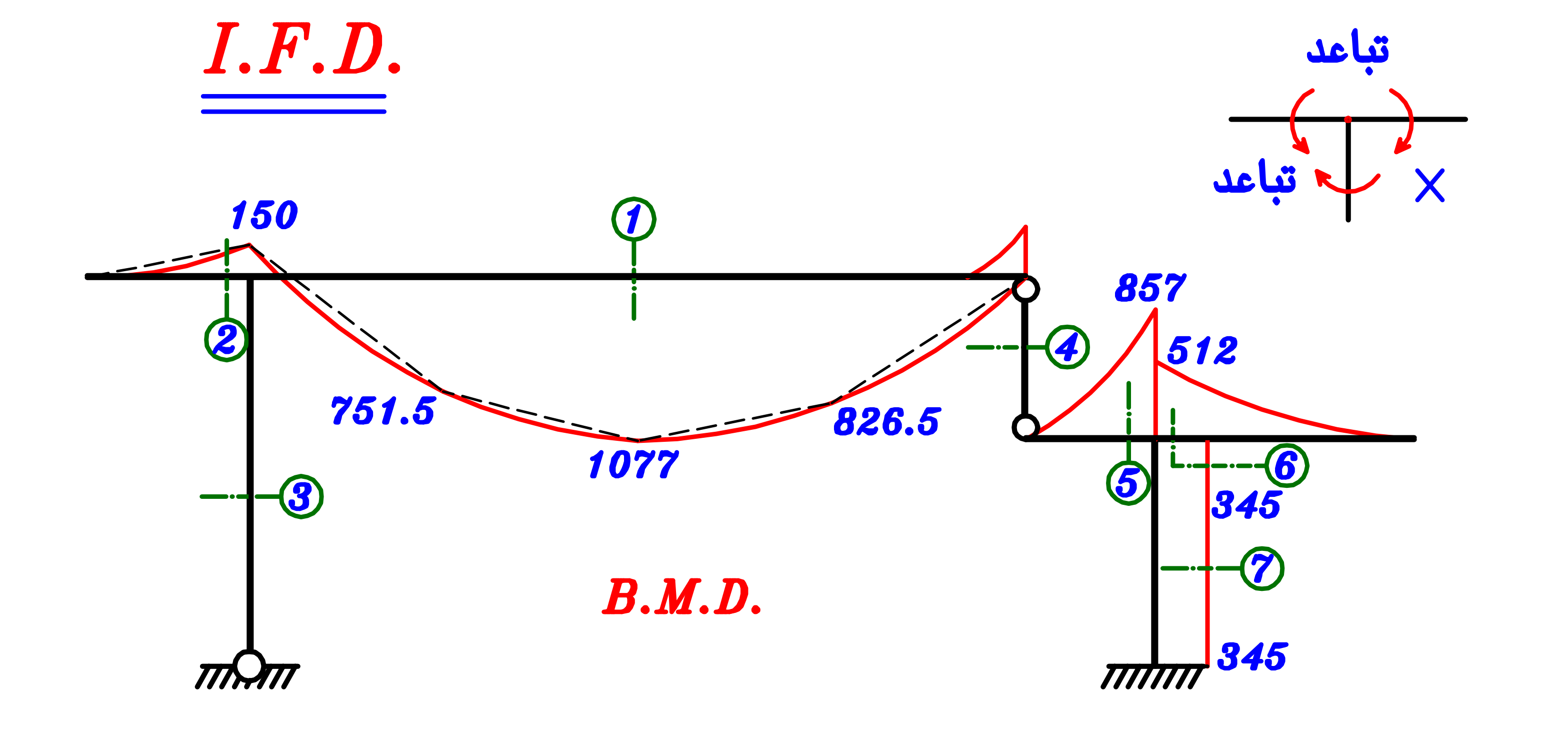
3.5

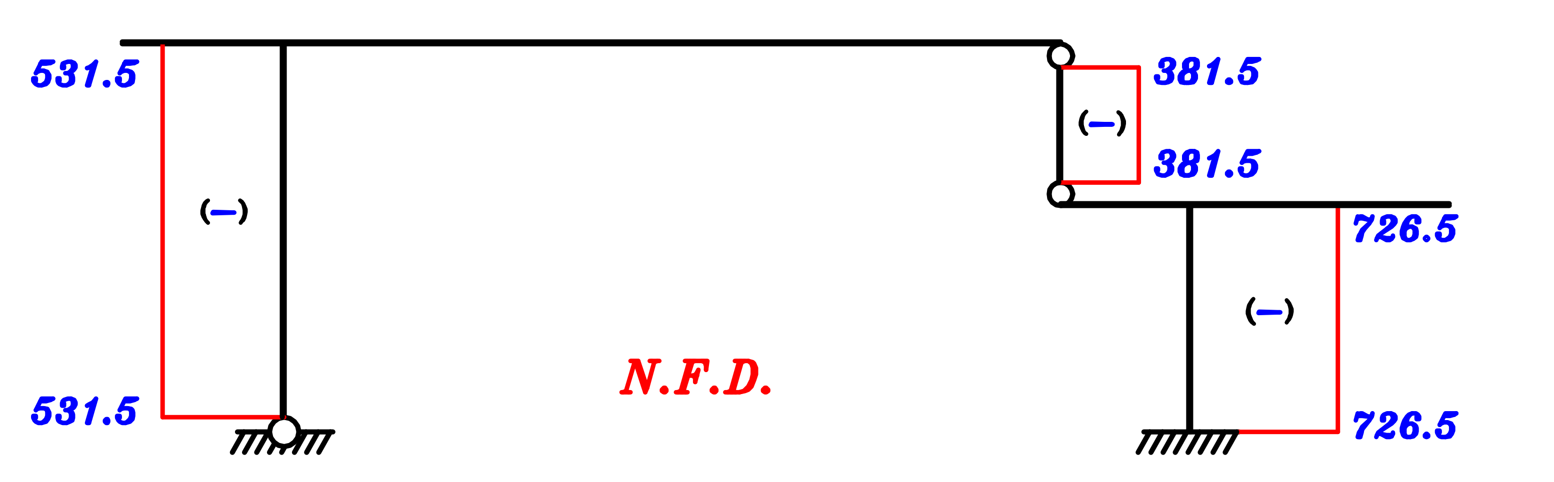
726.5 kN

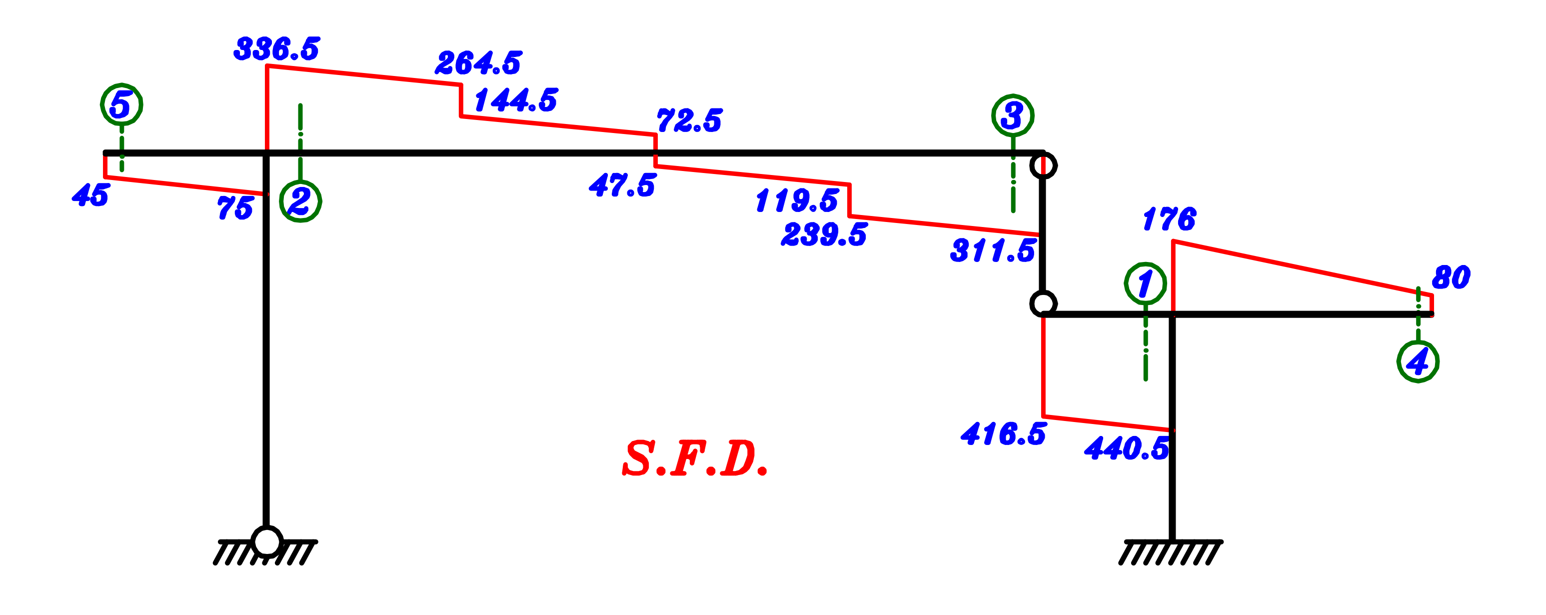
345 kN.m

2.0 4.0

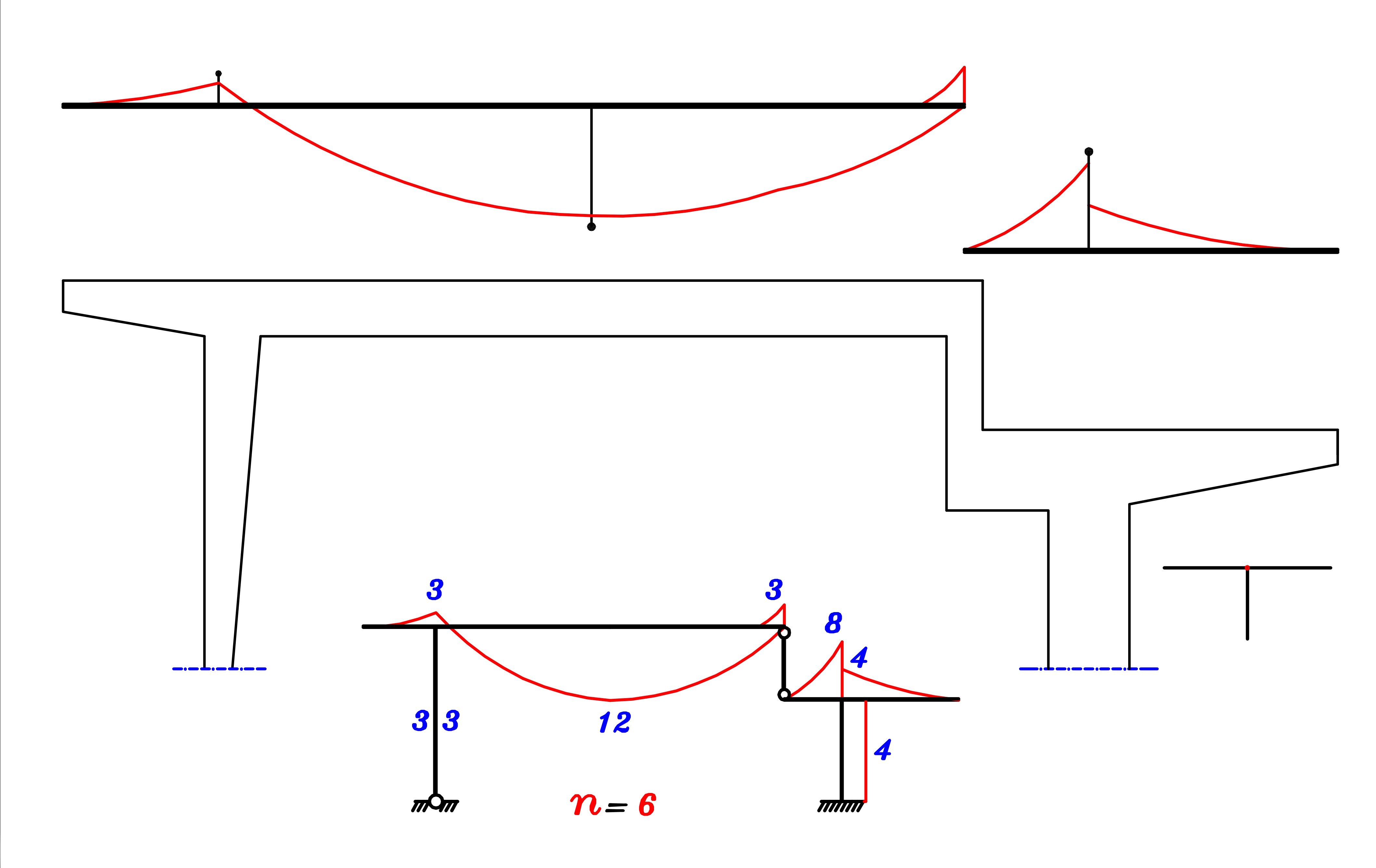
I.F.D.

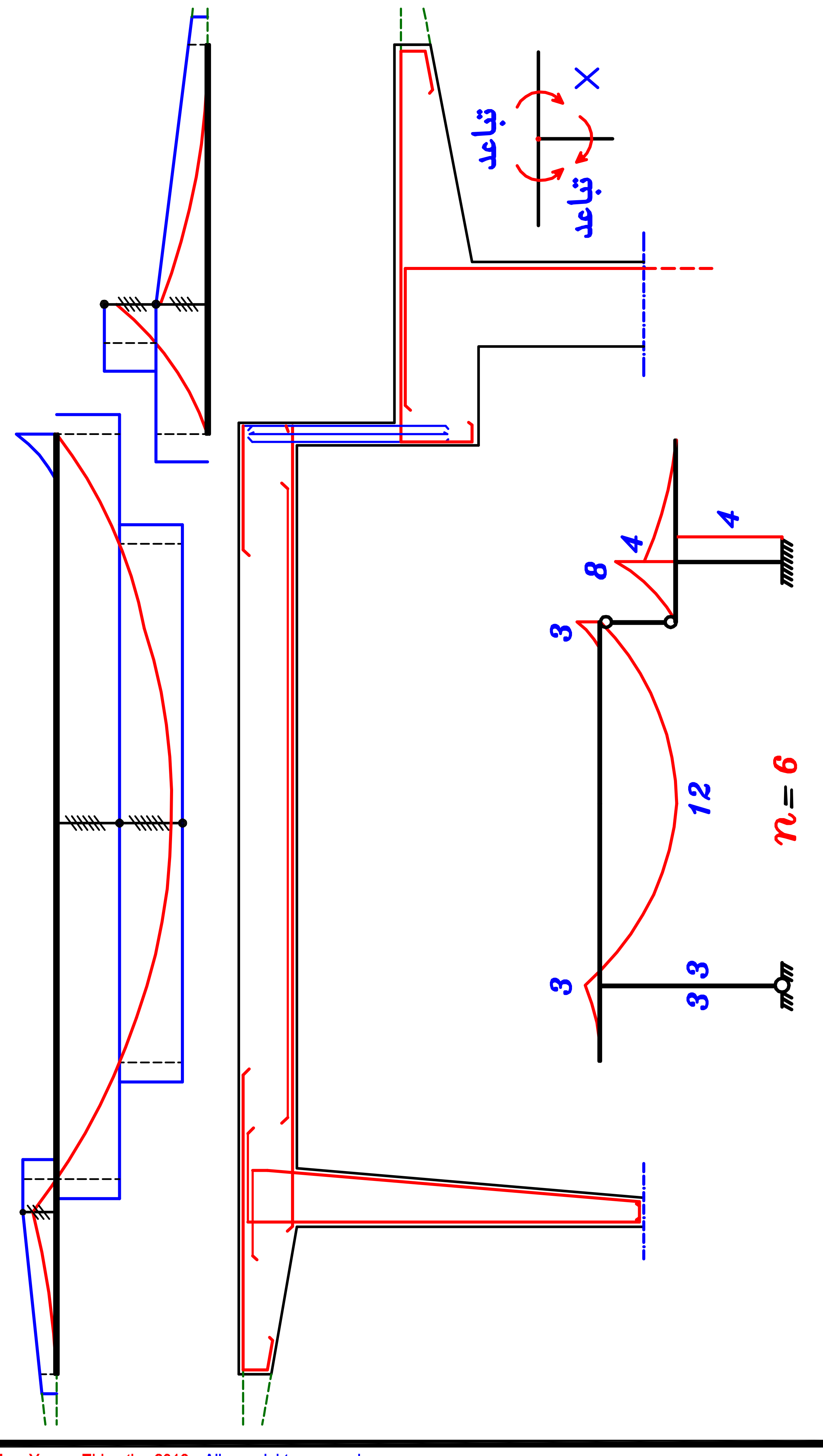

تباعد
تباعد
X
150
1
2
751.5
1077
826.5
4
857
512
5
6
345
3
7
345
B.M.D.

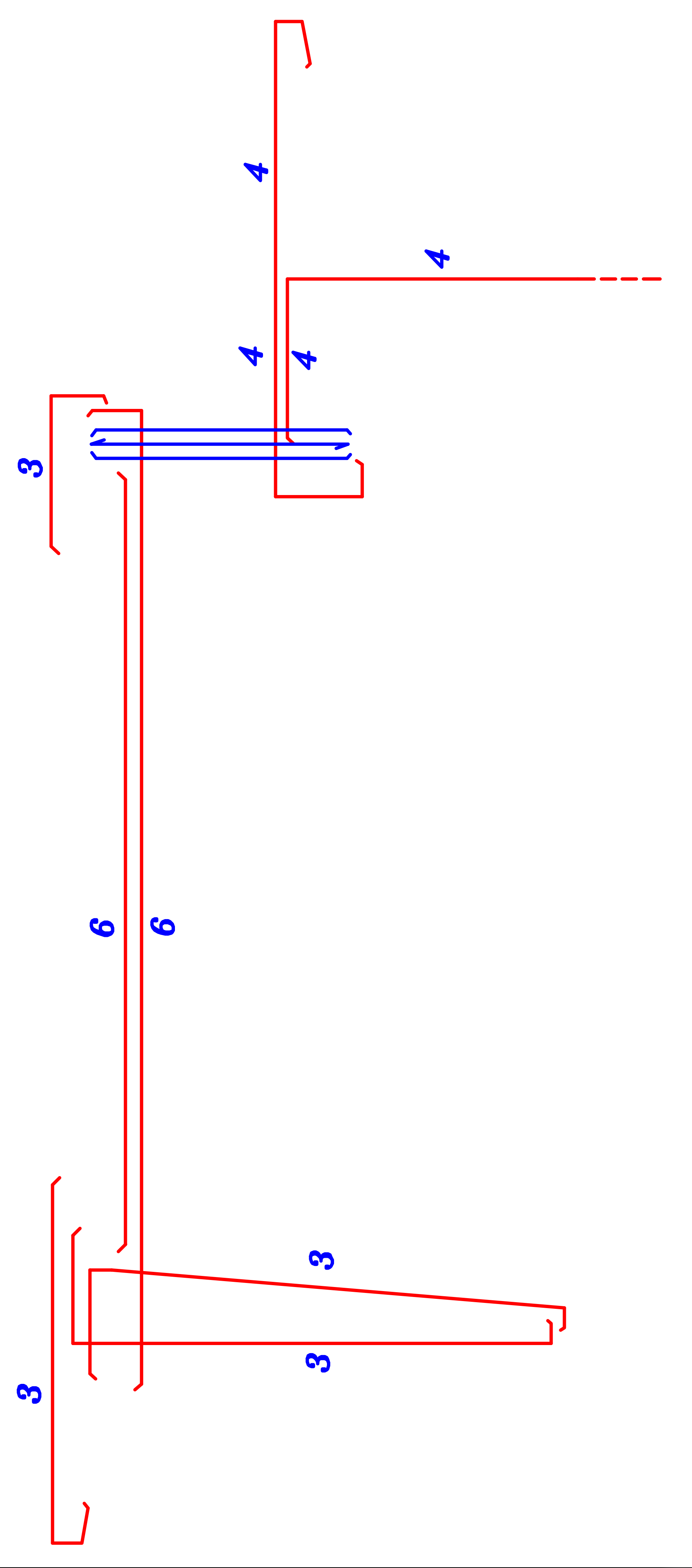

531.5
(–)
531.5
381.5
(–)
381.5
726.5
(–)
726.5
N.F.D.


336.5
264.5
144.5
72.5
5
3
45
75
2
47.5
119.5
239.5
311.5
176
1
80
4
416.5
440.5
S.F.D.

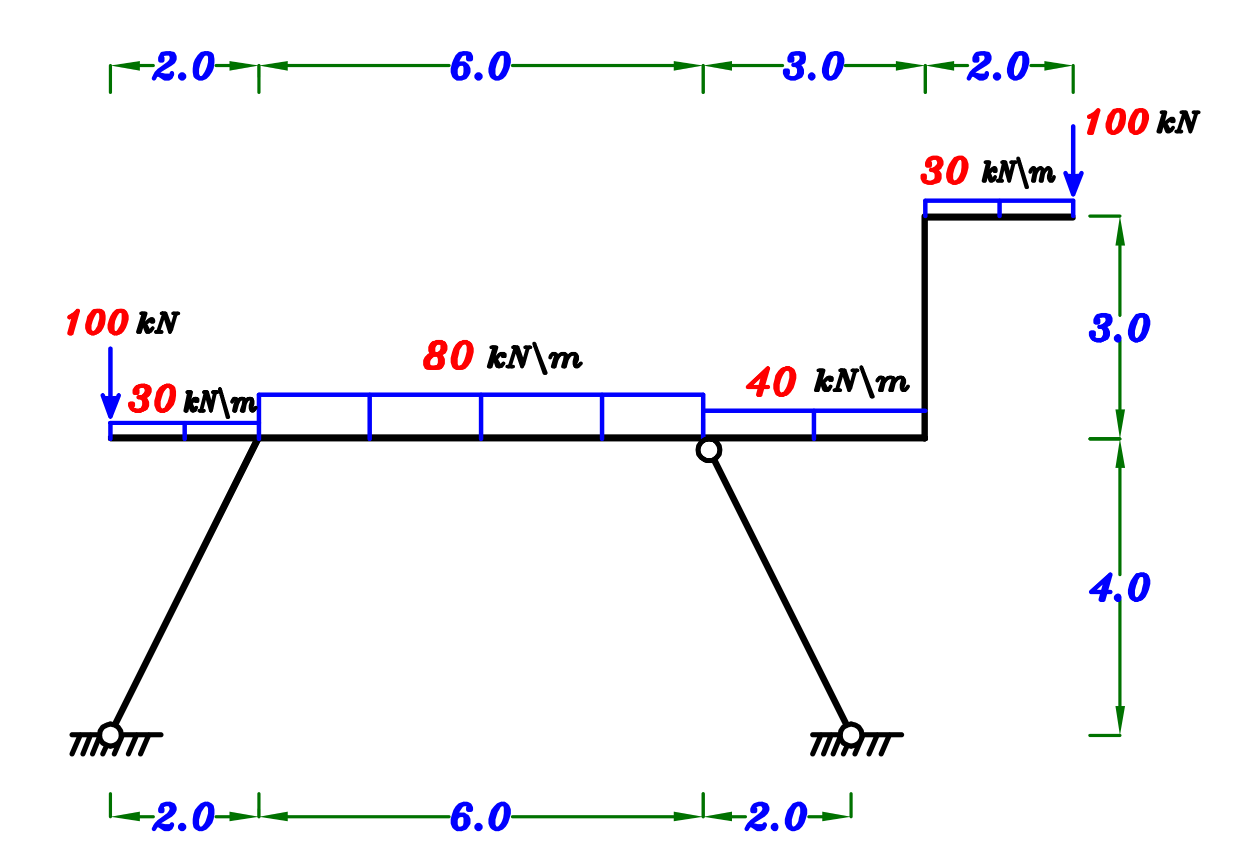
③ Draw Main RFT. & Blocks of moment of Resistance.




تباعد
تباعد
8
4
4
3
12
3
3
3
n = 6


4
4
4
4
3
6
6
3
3
3

Example.



1. Calculate the Reactions & Draw Internal Forces Diagrams.
2. Determine the critical sections in Bending & Shear For the Frame.
3. Draw Main RFT. only , making curtailment of steel using Moment of Resistance.

2.0 6.0 3.0 2.0

100 kN

30 kN\m

3.0

100 kN

80 kN\m

40 kN\m

30 kN\m

4.0

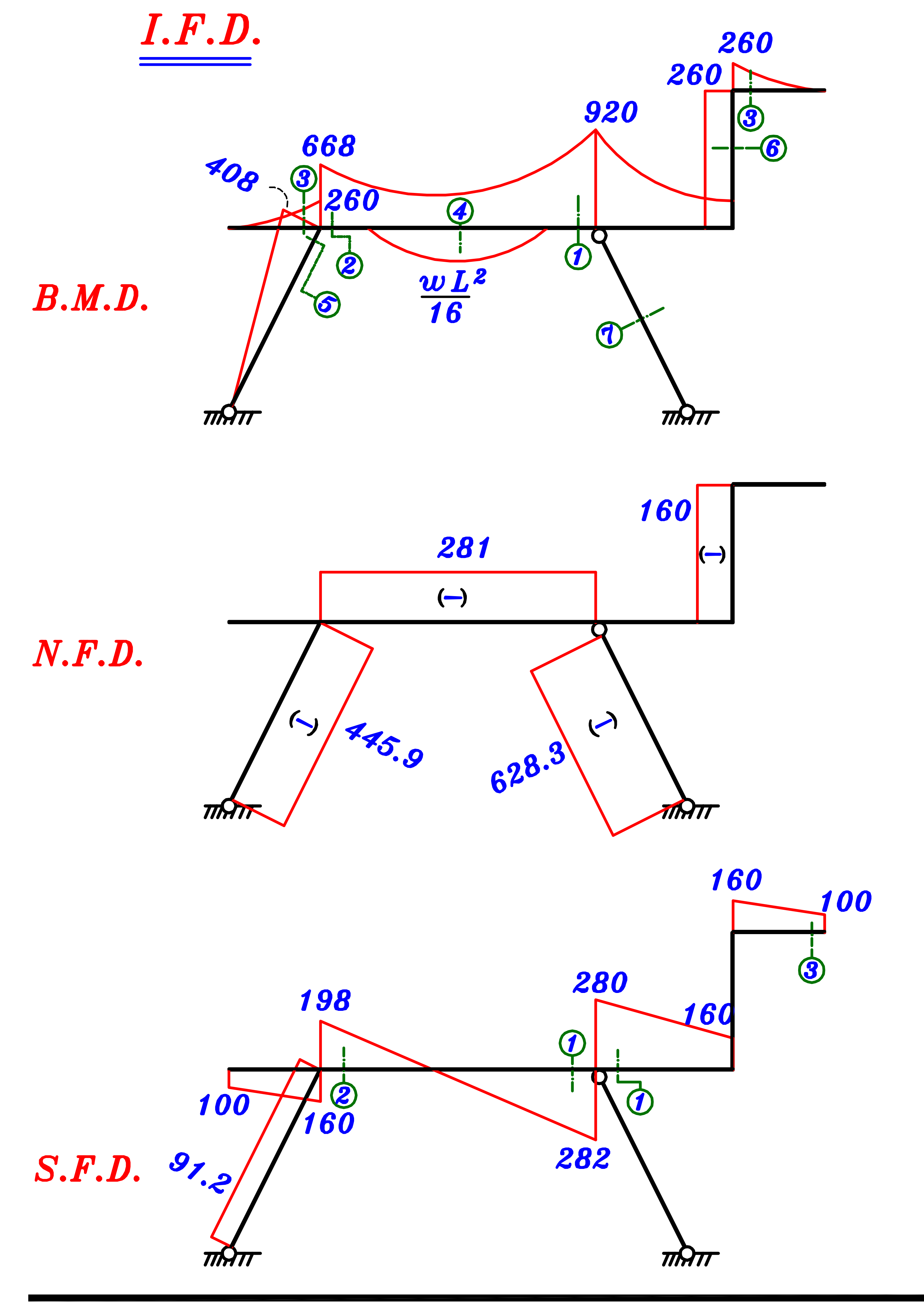
281 kN

281 kN

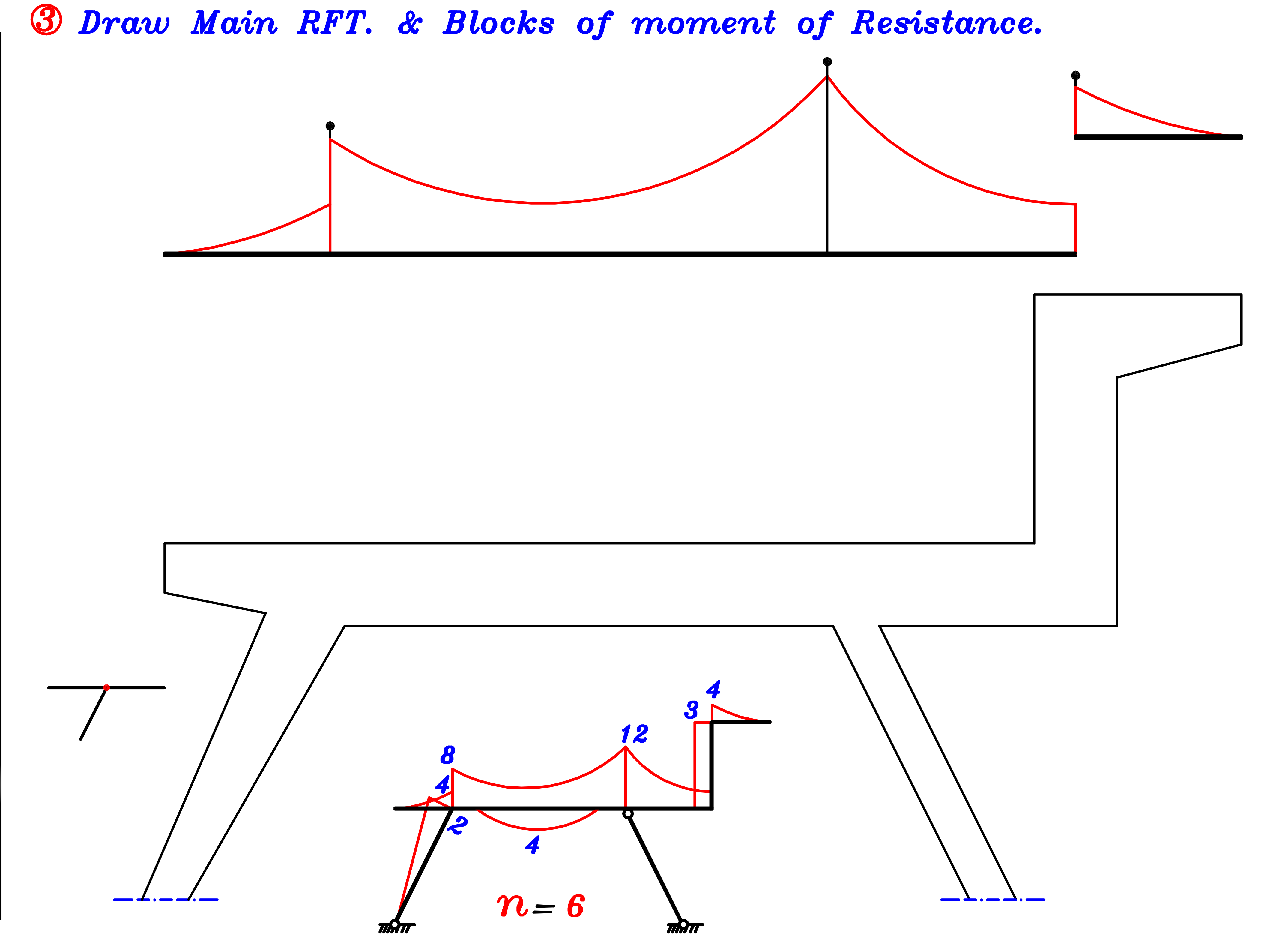
358 kN

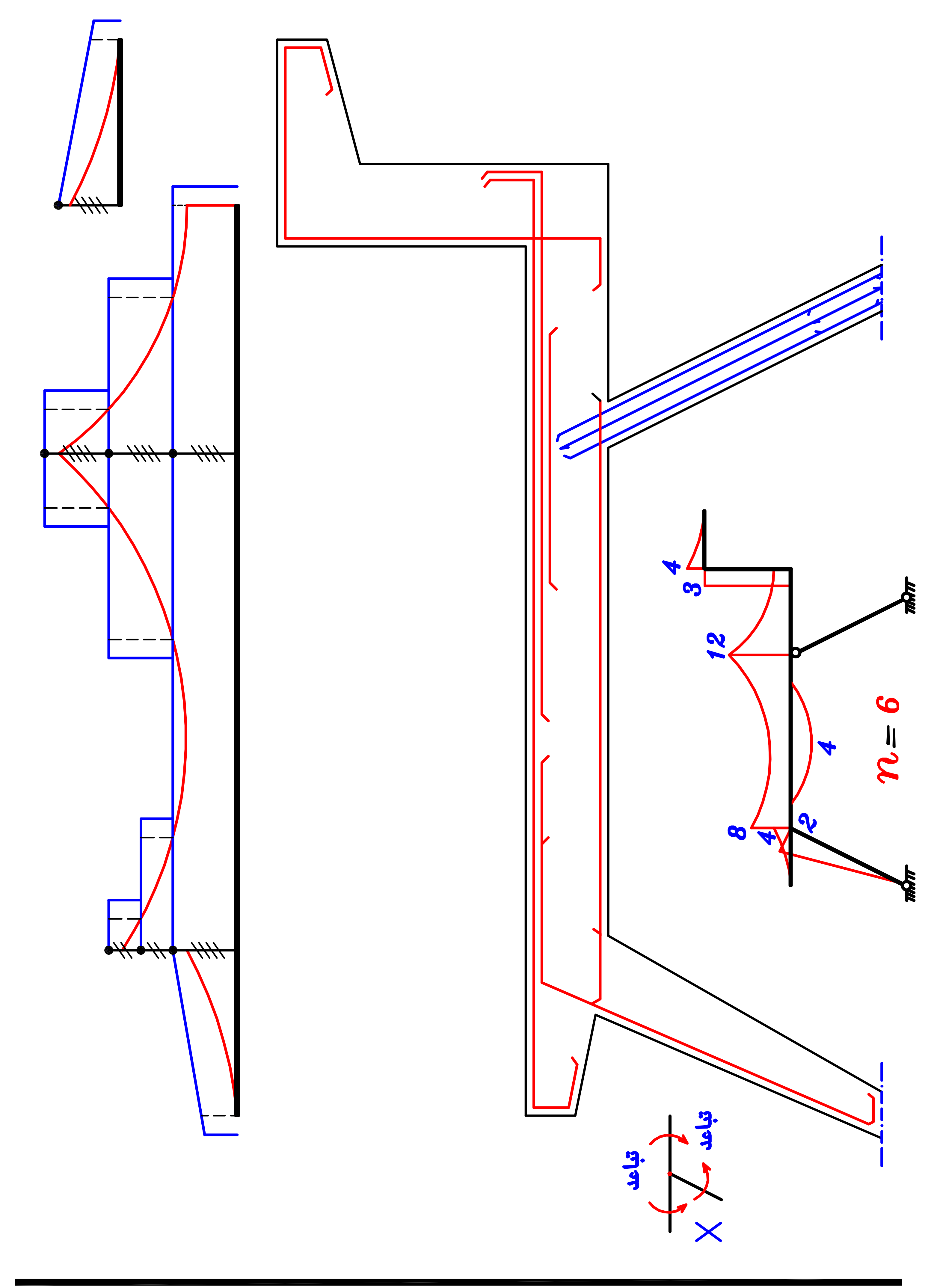
562 kN

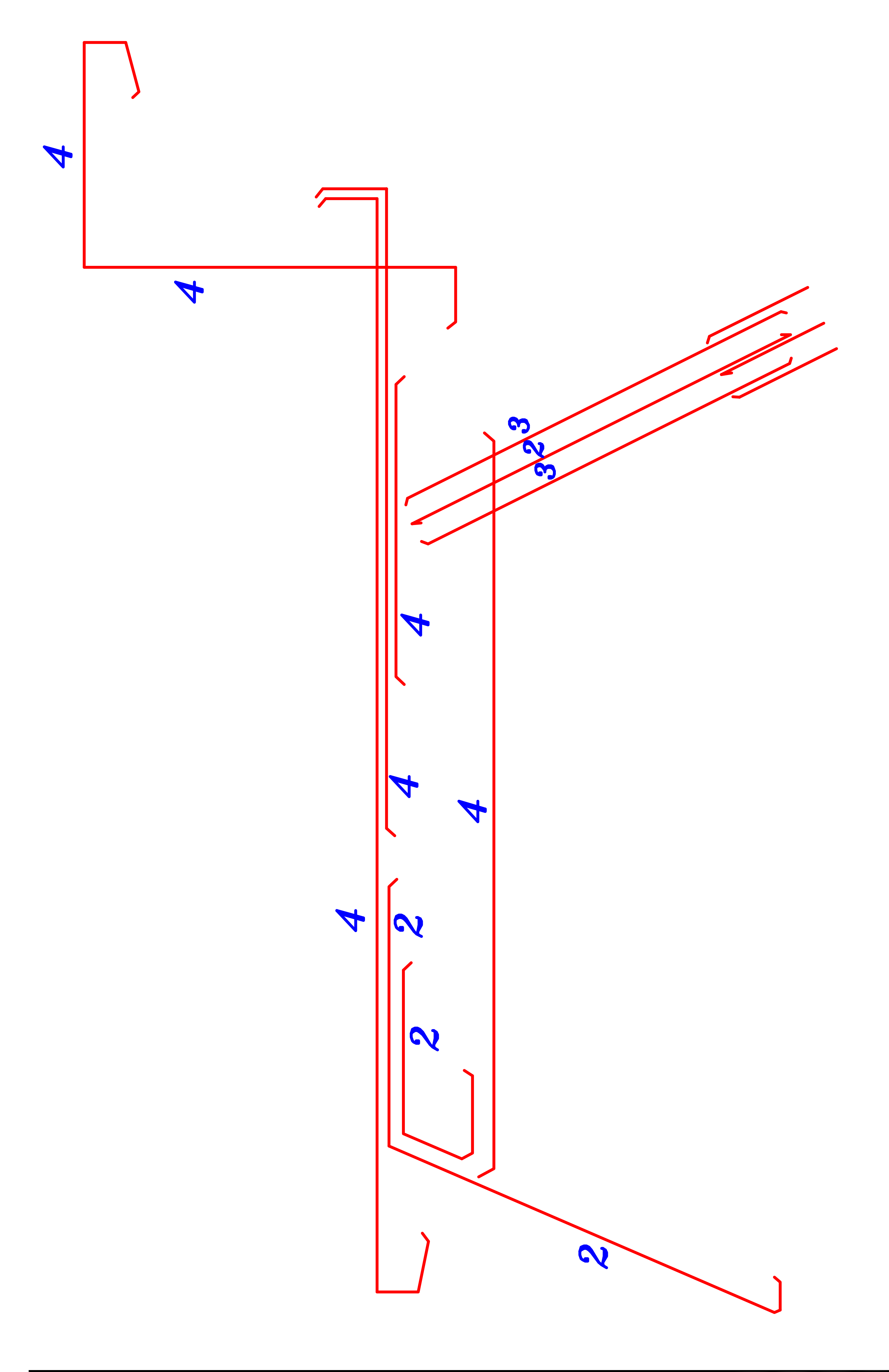
2.0 6.0 2.0


I.F.D.
B.M.D.
408
668
260
920
260
260
wL²
16
N.F.D.
281
160
445.9
628.3
S.F.D.
198
100
160
91.2
280
160
282
160
100

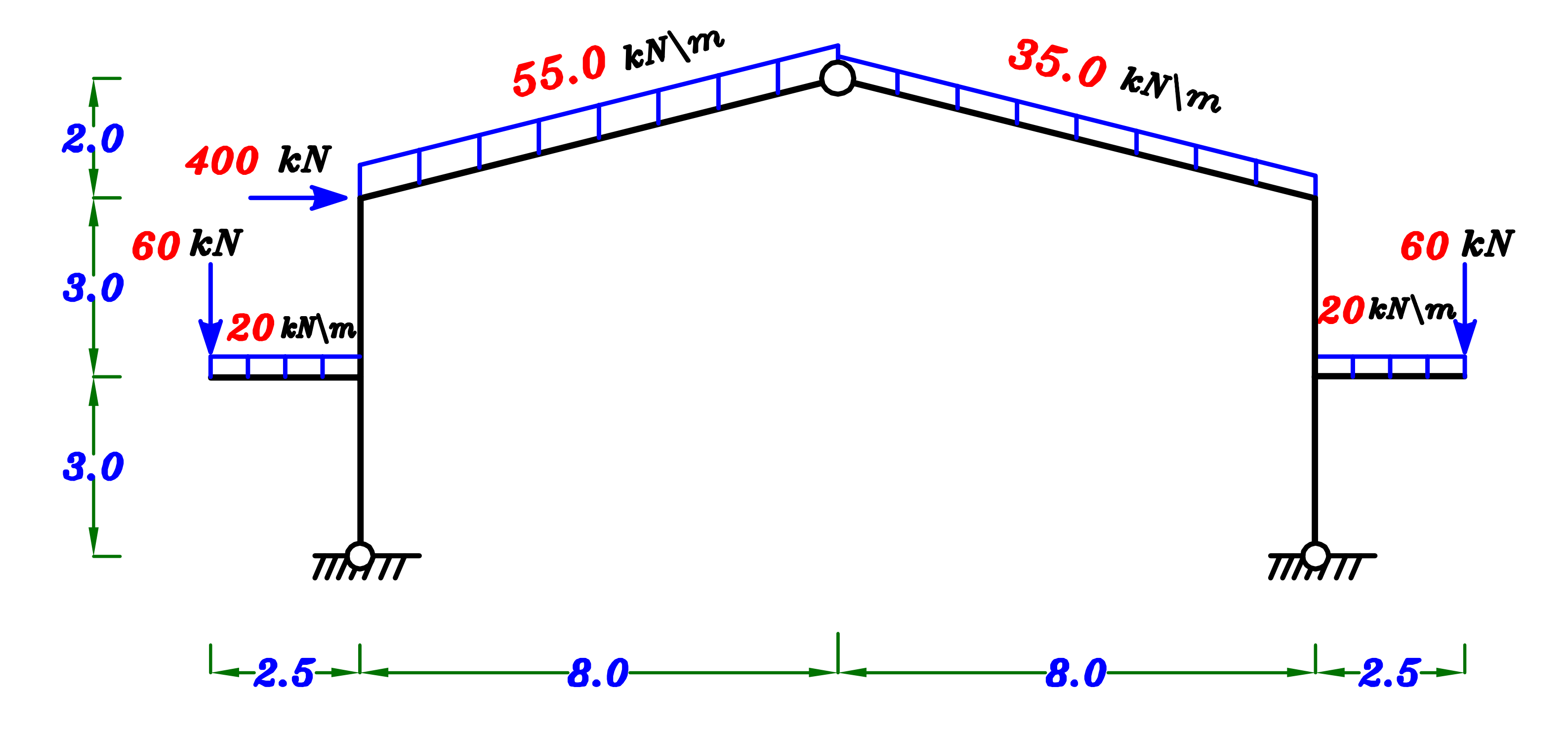
③ **Draw Main RFT. & Blocks of moment of Resistance.**




4
3
12
4
8
4
2
n = 6


4
4
3
2
3
4
4
4
4
2
2
2

Example.

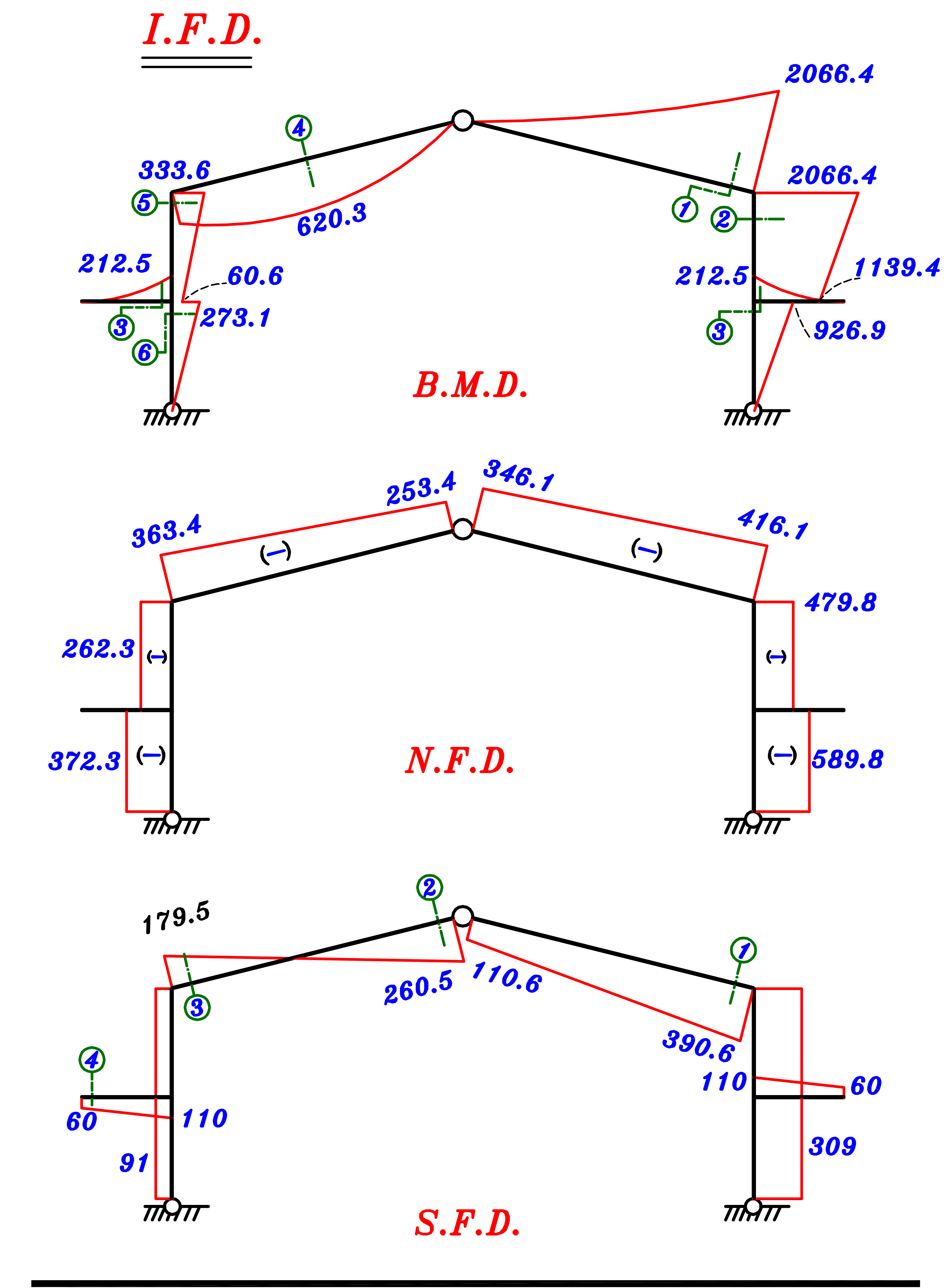


① Calculate the Reactions & Draw Internal Forces Diagrams.

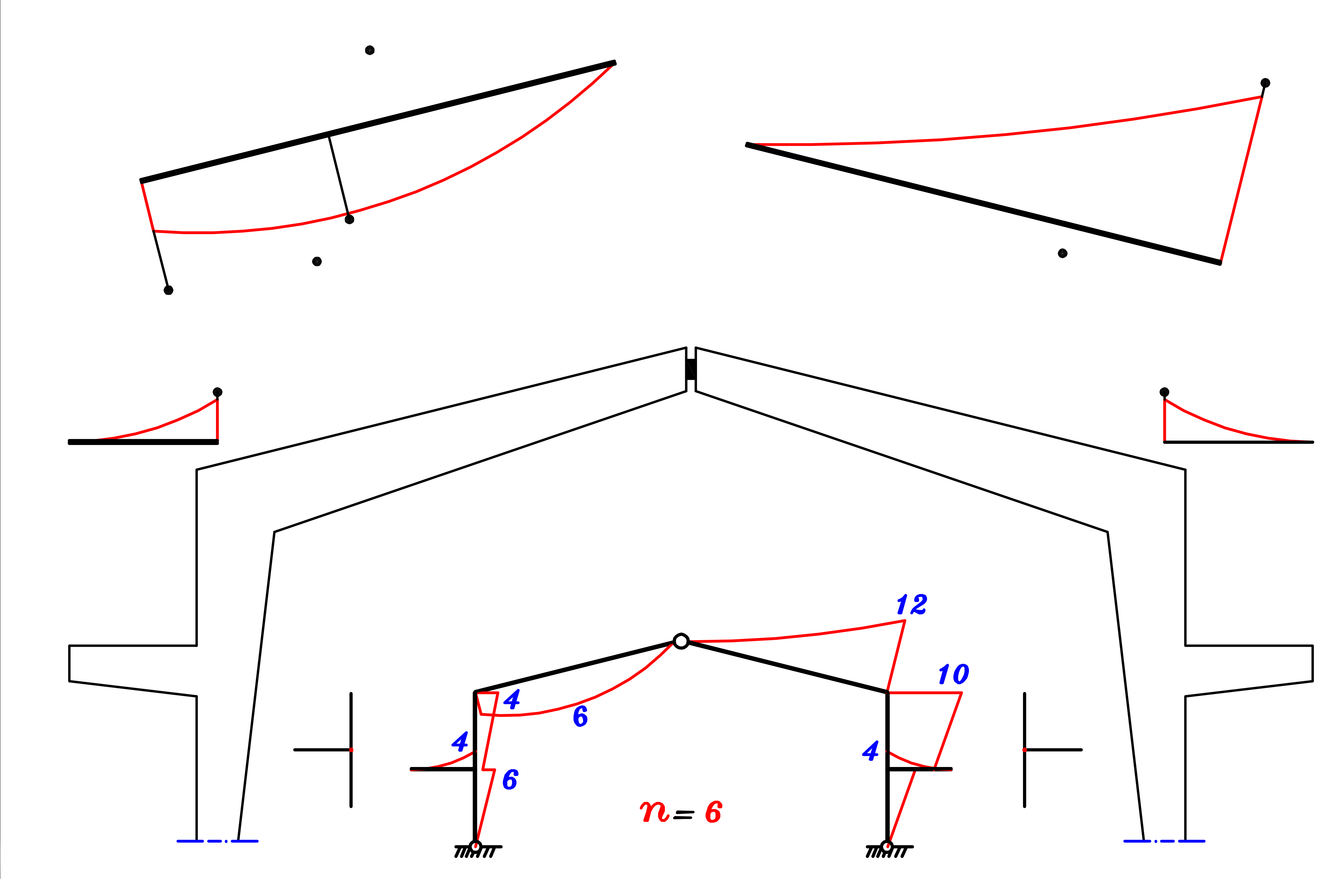
② Determine the critical sections in Bending & Shear For the Frame.

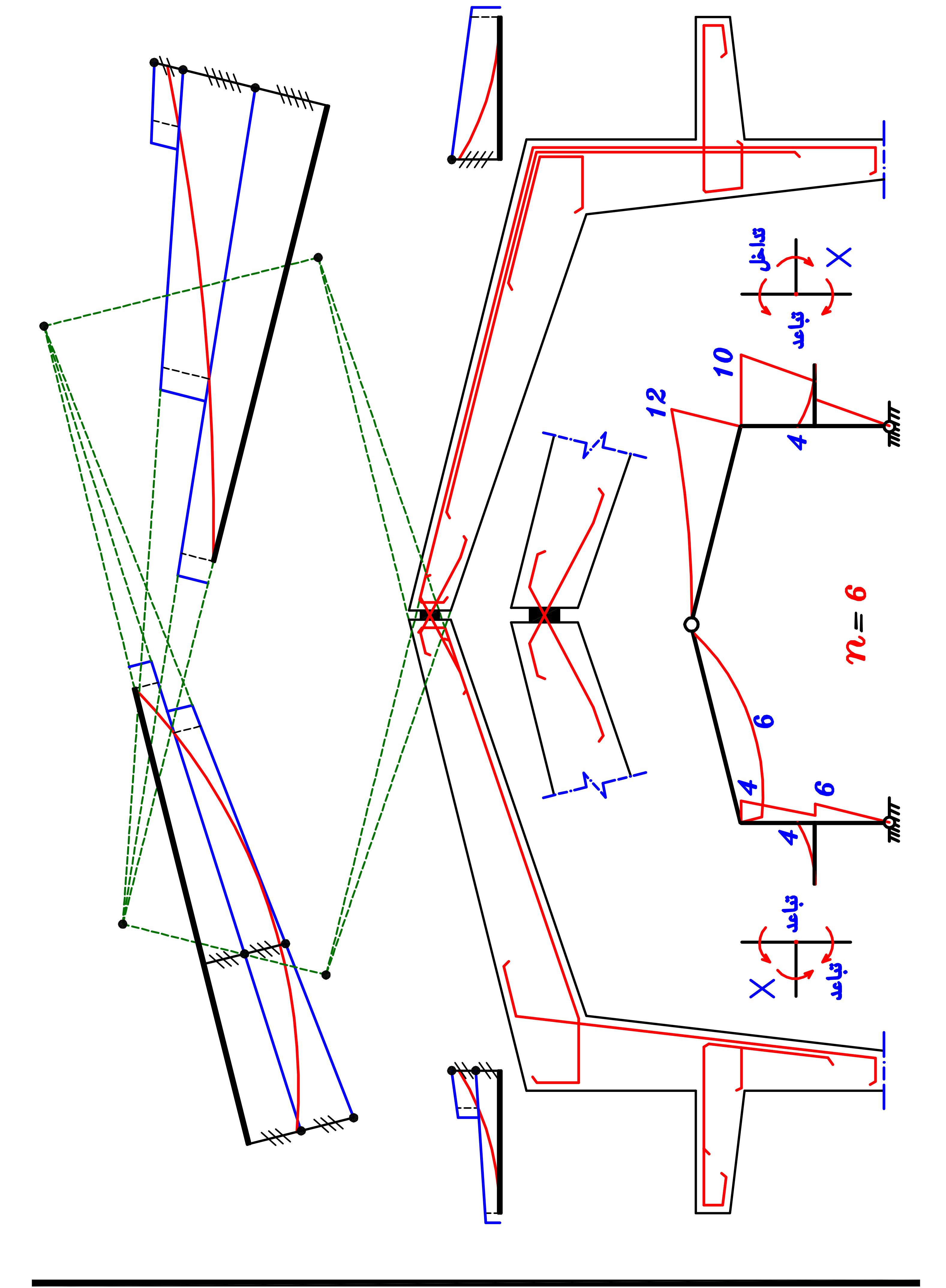
③ Draw Main RFT. only , making curtailment of steel using Moment of Resistance.

55.0 kN\m
35.0 kN\m
400 kN
60 kN
20 kN\m
60 kN
20 kN\m
2.0
3.0
3.0
91.0 kN
309 kN
372.3 kN
589.8 kN
2.5
8.0
8.0
2.5

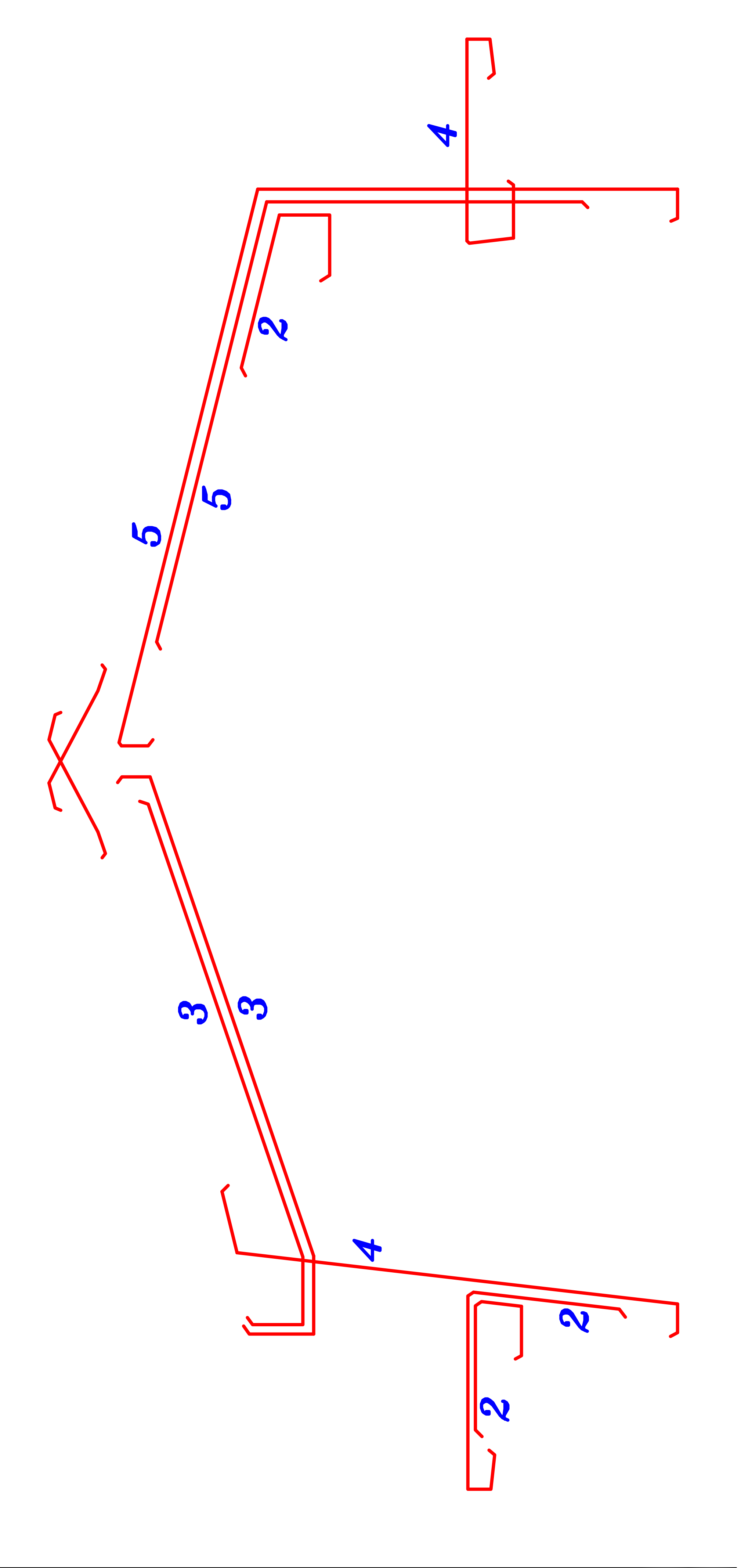

I.F.D.
2066.4
333.6
2066.4
620.3
212.5
60.6
212.5
1139.4
273.1
926.9
B.M.D.
253.4
346.1
363.4
416.1
(−)
(−)
479.8
262.3
(−)
(−)
372.3
(−)
(−)
589.8
N.F.D.
179.5
260.5
110.6
390.6
110
60
60
110
309
91
S.F.D.

③ Draw Main RFT. & Blocks of moment of Resistance.

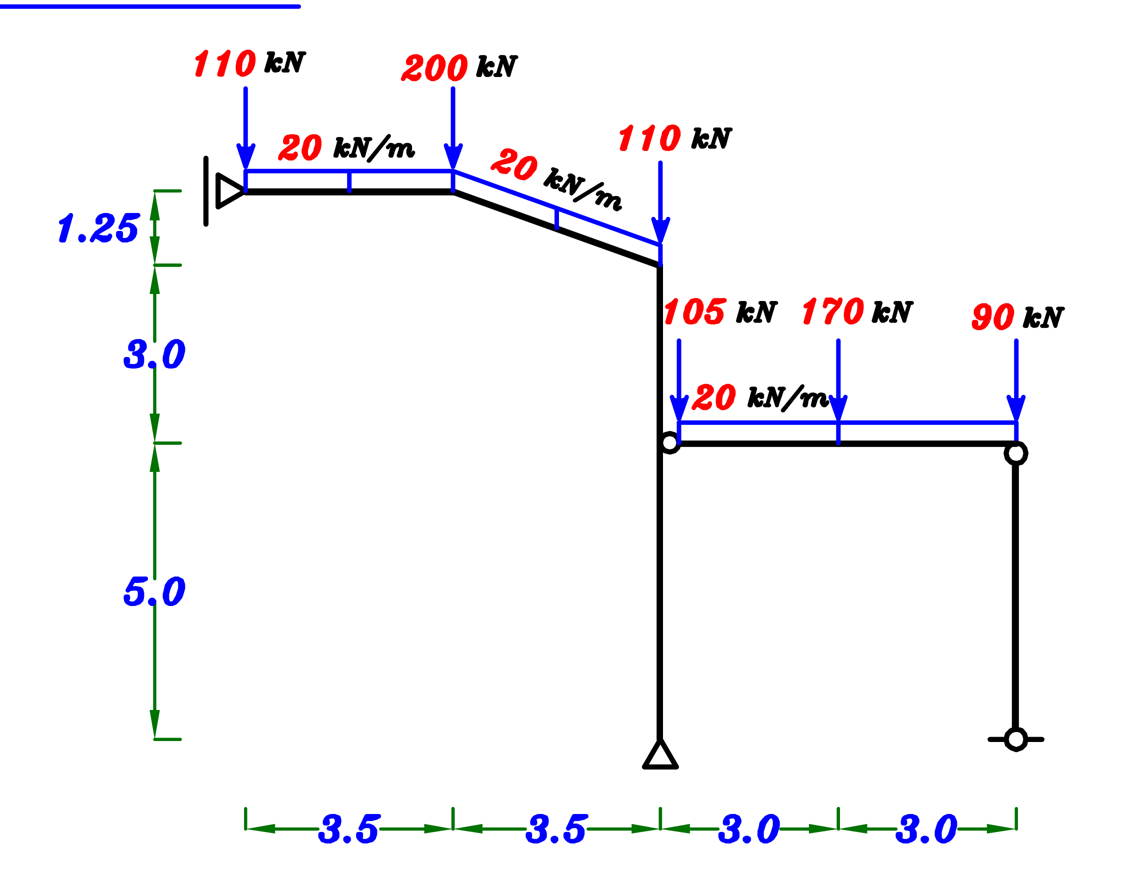




n = 6
12
10
4
6
6
4
4
تداخل
تباعد
تباعد
تباعد


4
2
5
5
3
3
4
2
2

Example.

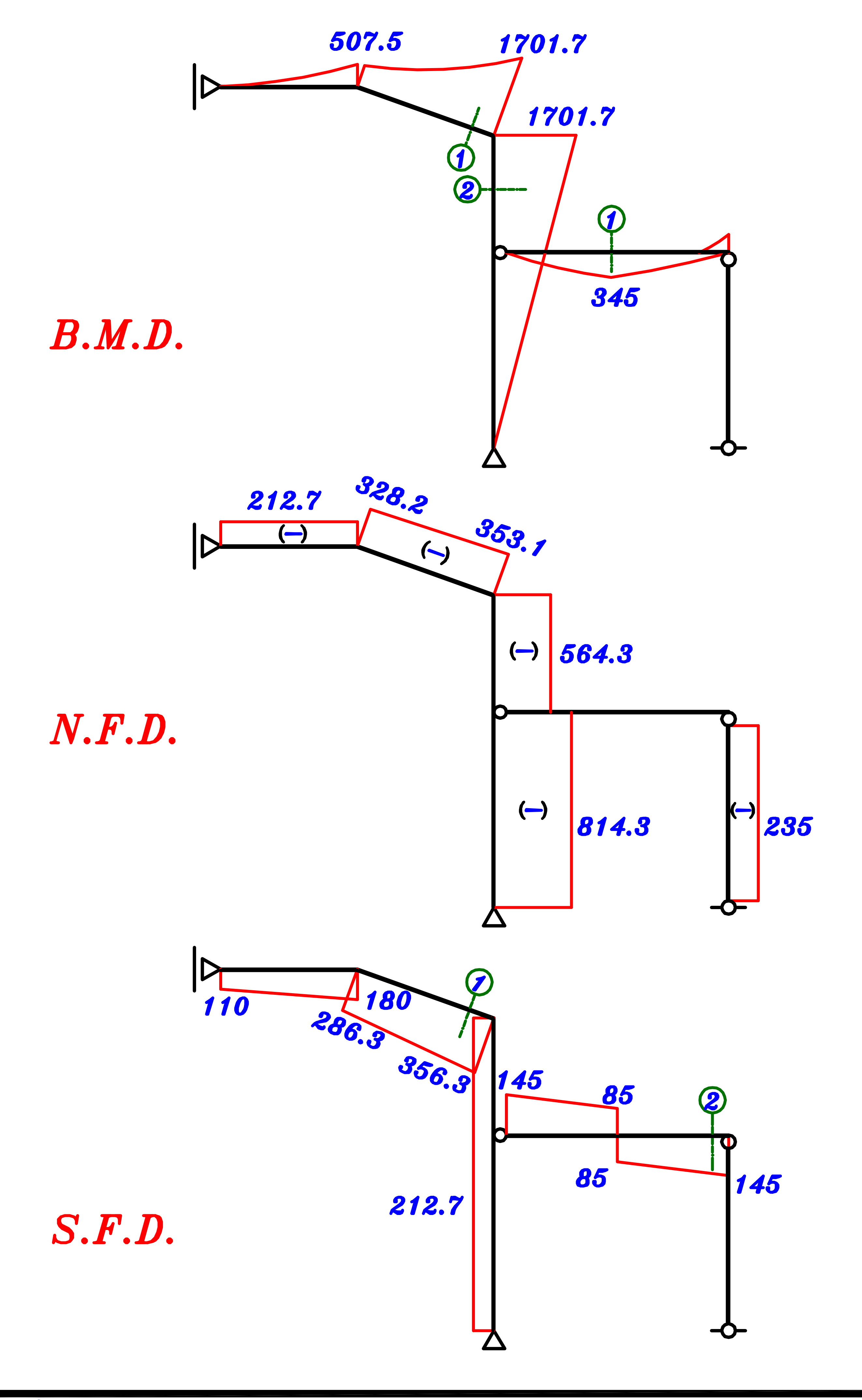


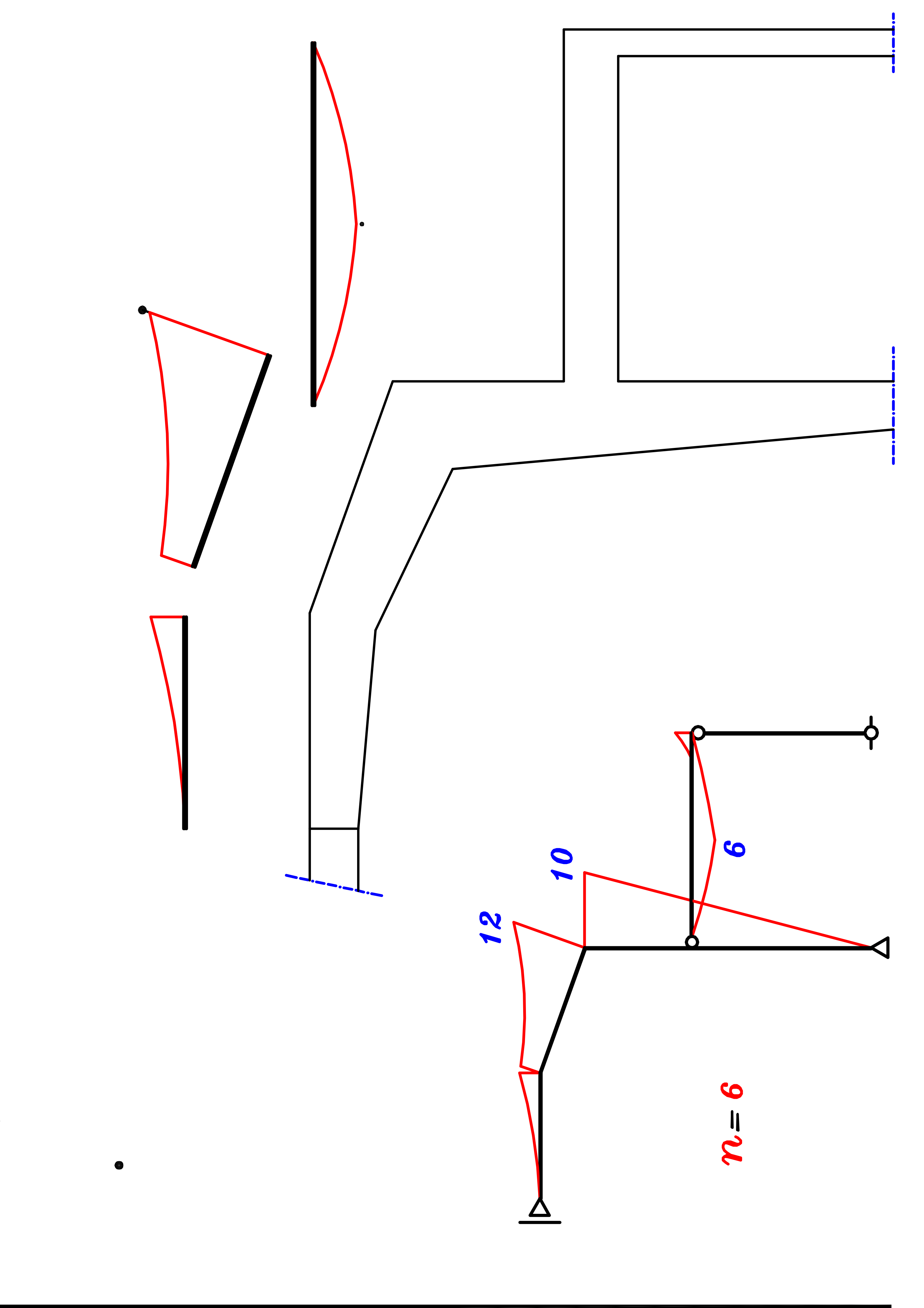
① Calculate the Reactions & Draw Internal Forces Diagrams.

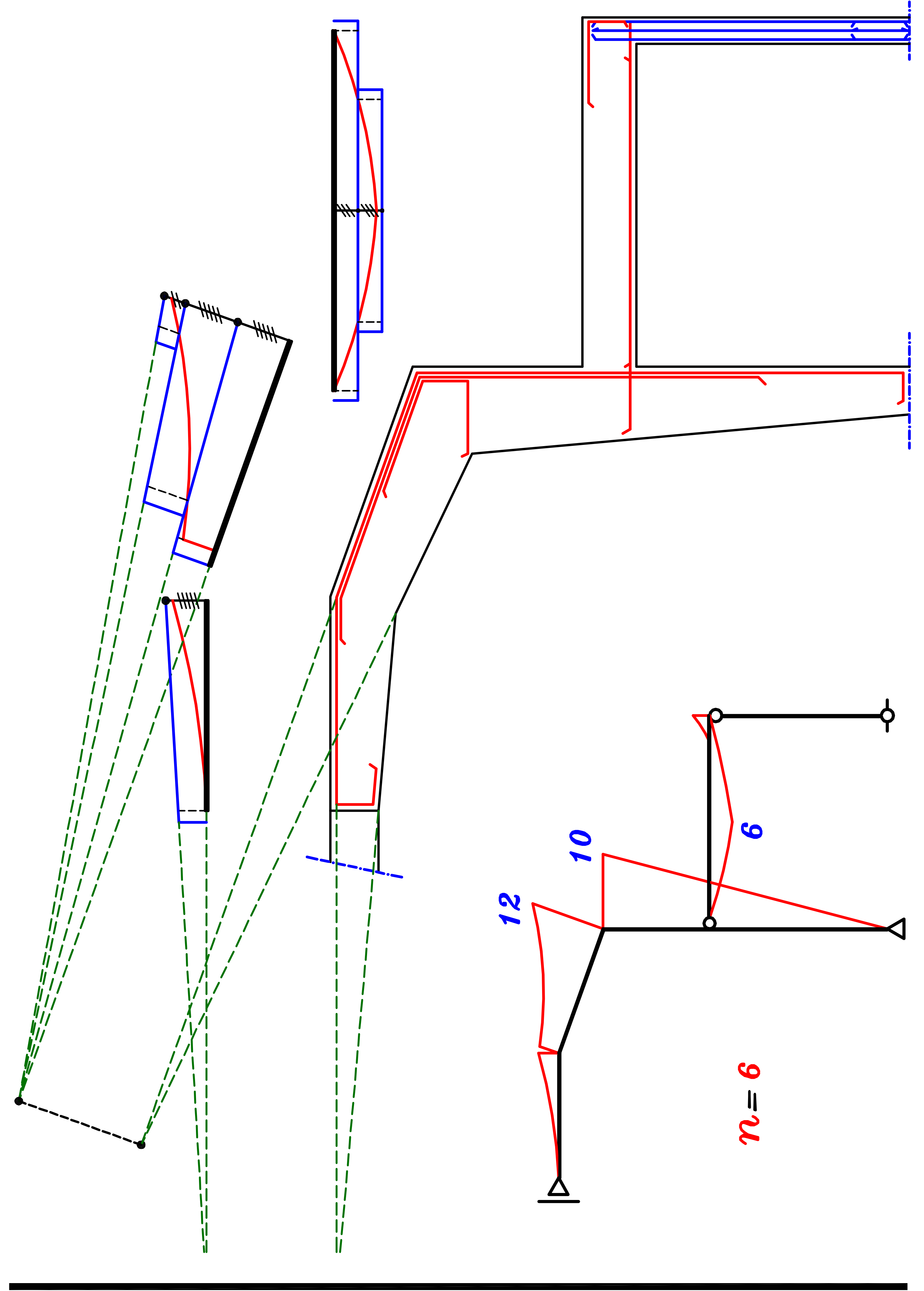
② Determine the critical sections in Bending & Shear For the Frame.

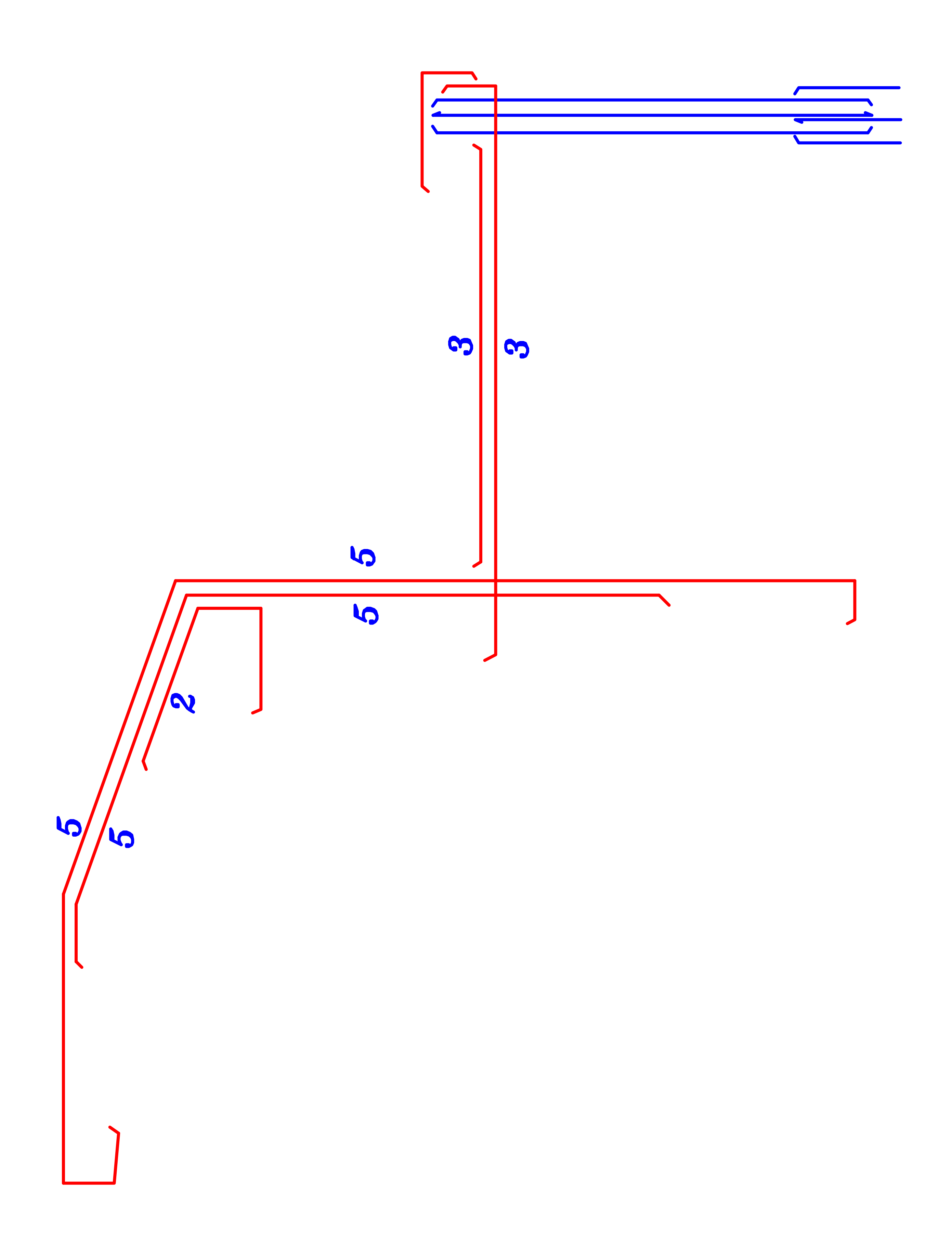
③ Draw Main RFT. only , making curtailment of steel using Moment of Resistance.

110 kN
200 kN
212.7 kN
20 kN/m
20 kN/m
110 kN
1.25
3.0
5.0
105 kN
170 kN
90 kN
20 kN/m
X_2= 212.7 kN
815.6 kN
233.8 kN
3.5
3.5
3.0
3.0

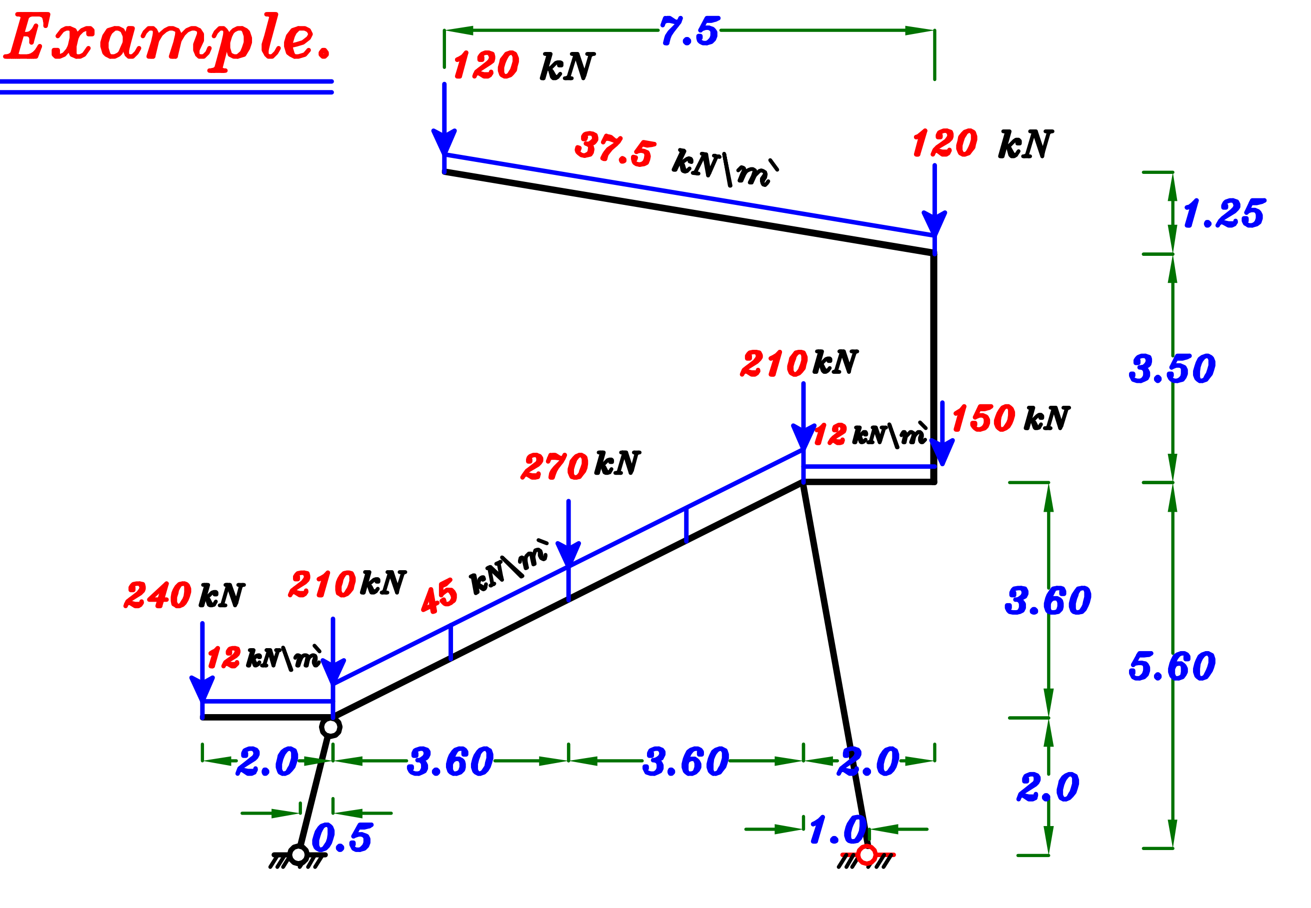

507.5
1701.7
1701.7
1
2
1
345
B.M.D.
212.7
328.2
353.1
(−)
(−)
(−)
564.3
N.F.D.
(−)
814.3
(−)
235
110
180
1
286.3
356.3
145
85
2
85
145
212.7
S.F.D.


12
10
6
n = 6


12
10
6
n = 6


3
3
5
5
2
5
5

Example.

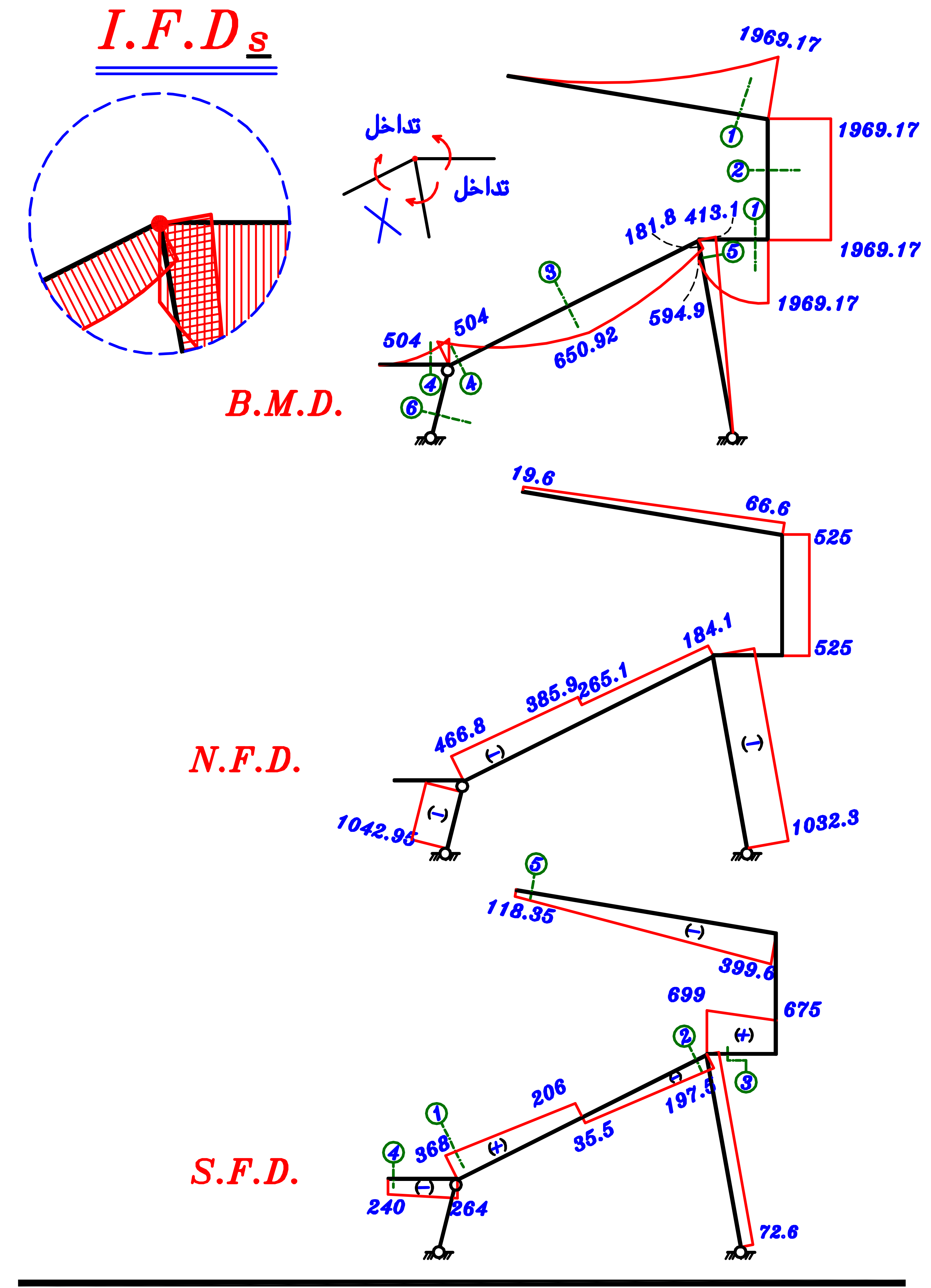


① Calculate the Reactions & Draw Internal Forces Diagrams.

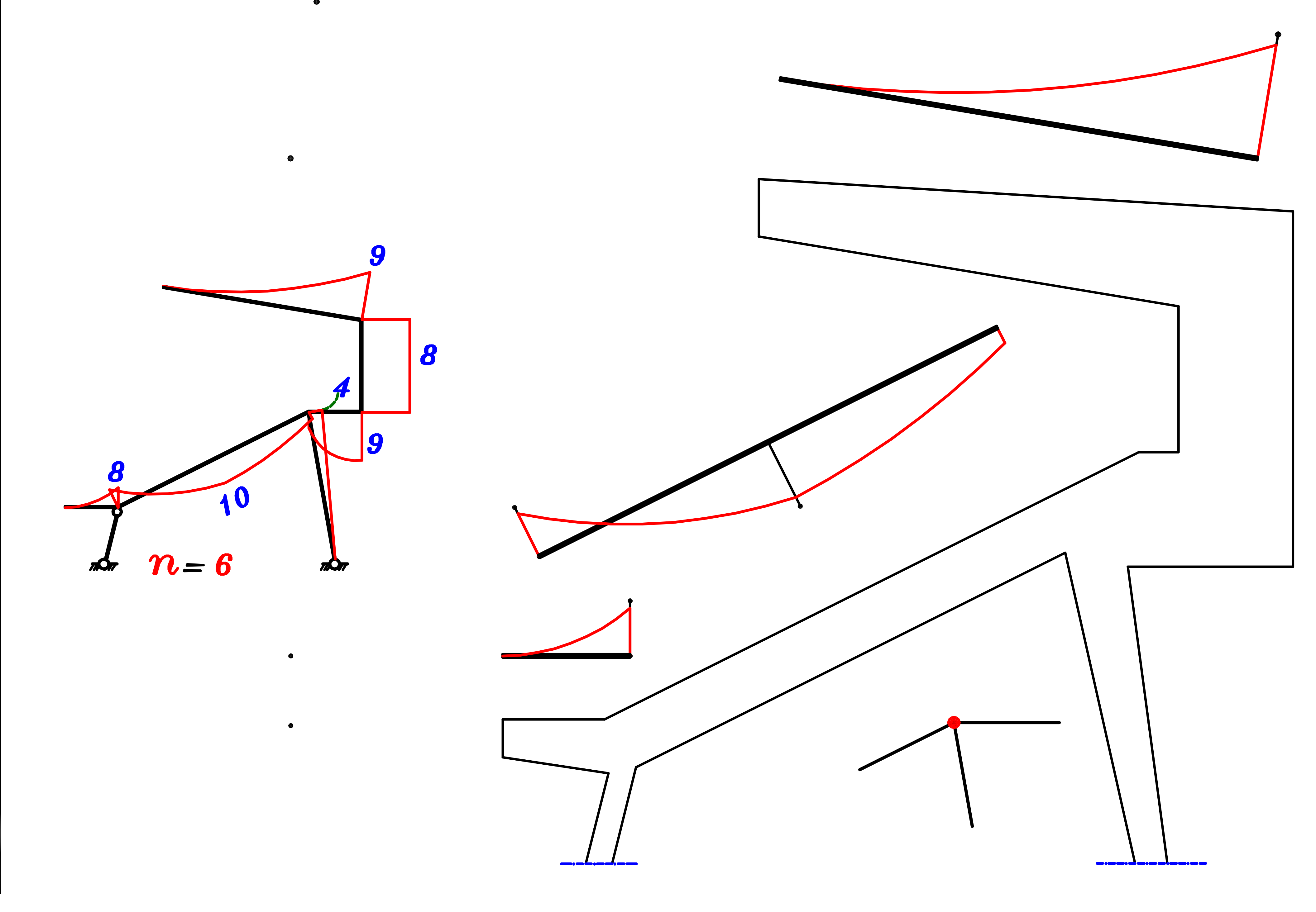
② Determine the critical sections in Bending & Shear For the Frame.

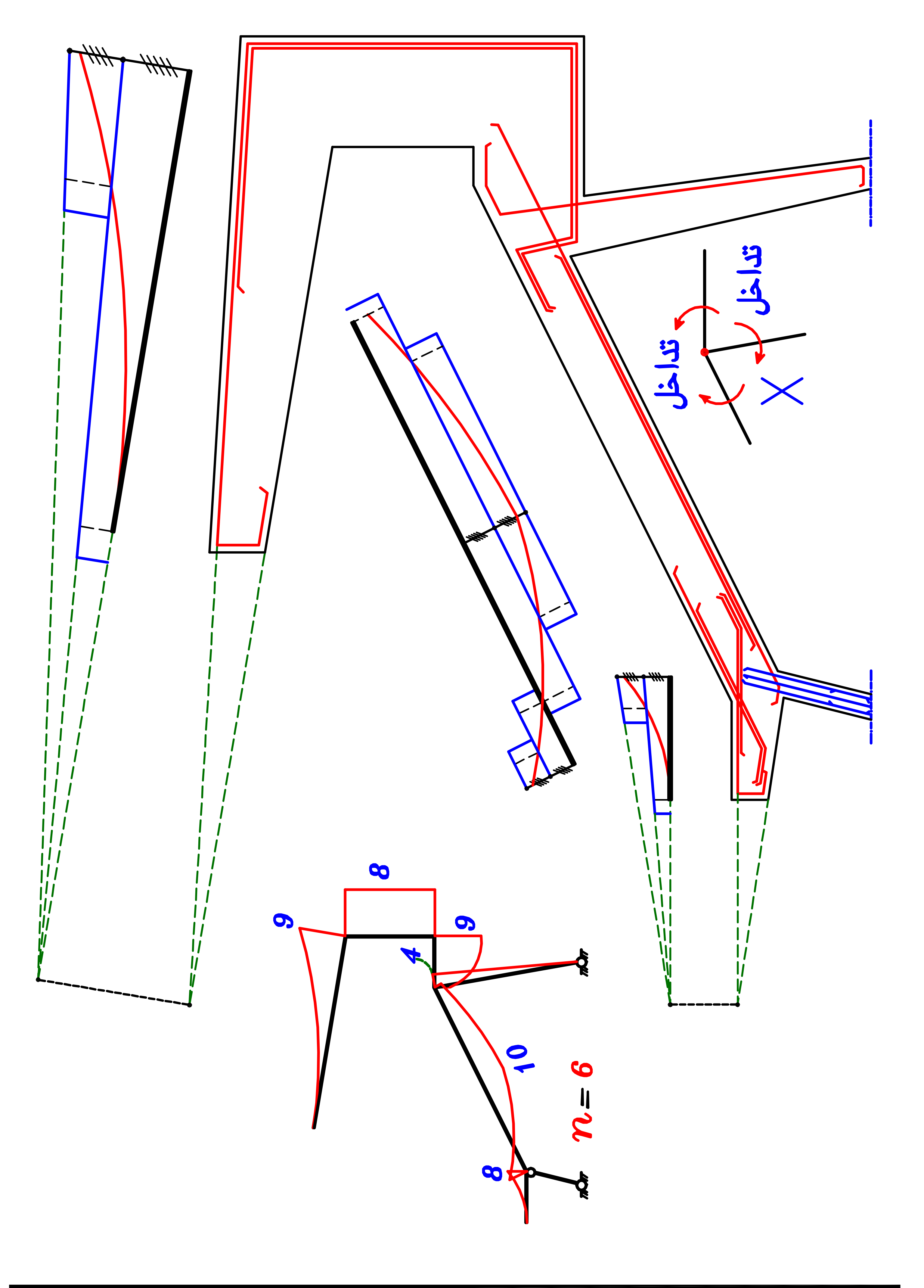
③ Draw Main RFT. only , making curtailment of steel using Moment of Resistance.

7.5
120 kN
37.5 kN\m`
120 kN
1.25
3.50
210 kN
12 kN\m`
150 kN
270 kN
45 kN\m`
240 kN
210 kN
12 kN\m`
3.60
5.60
2.0
3.60
3.60
2.0
0.5
1.0
2.0
252.96 kN
252.96 kN
1011.85 kN
1003.48 kN

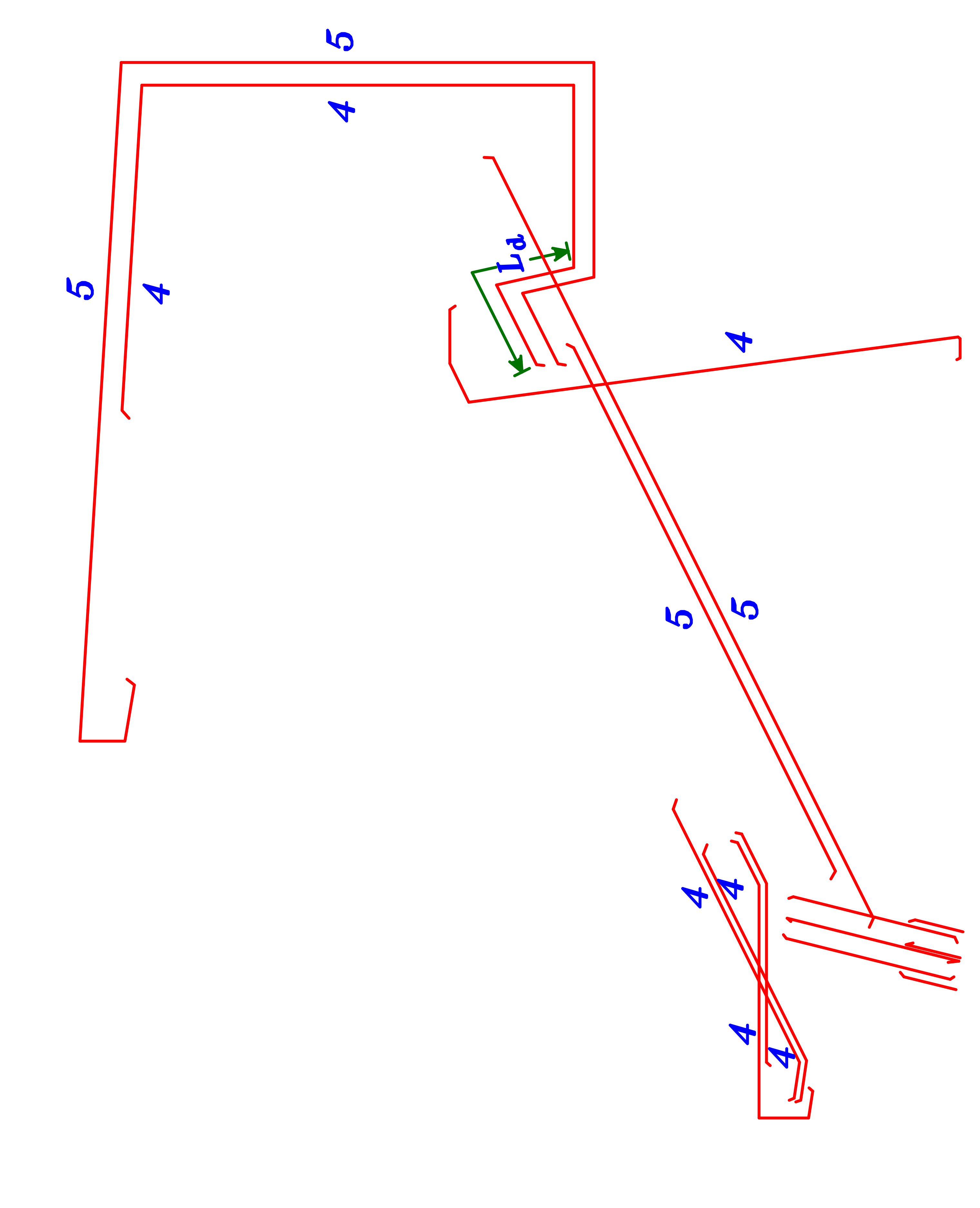

I.F.Ds
تداخل
تداخل
B.M.D.
1969.17
1969.17
1969.17
1969.17
181.8
413.1
594.9
650.92
504
504
N.F.D.
19.6
66.6
525
525
184.1
265.1
385.9
466.8
1042.95
1032.3
S.F.D.
118.35
399.6
699
675
197.5
206
35.5
368
240
264
72.6

③ Draw Main RFT. & Blocks of moment of Resistance.

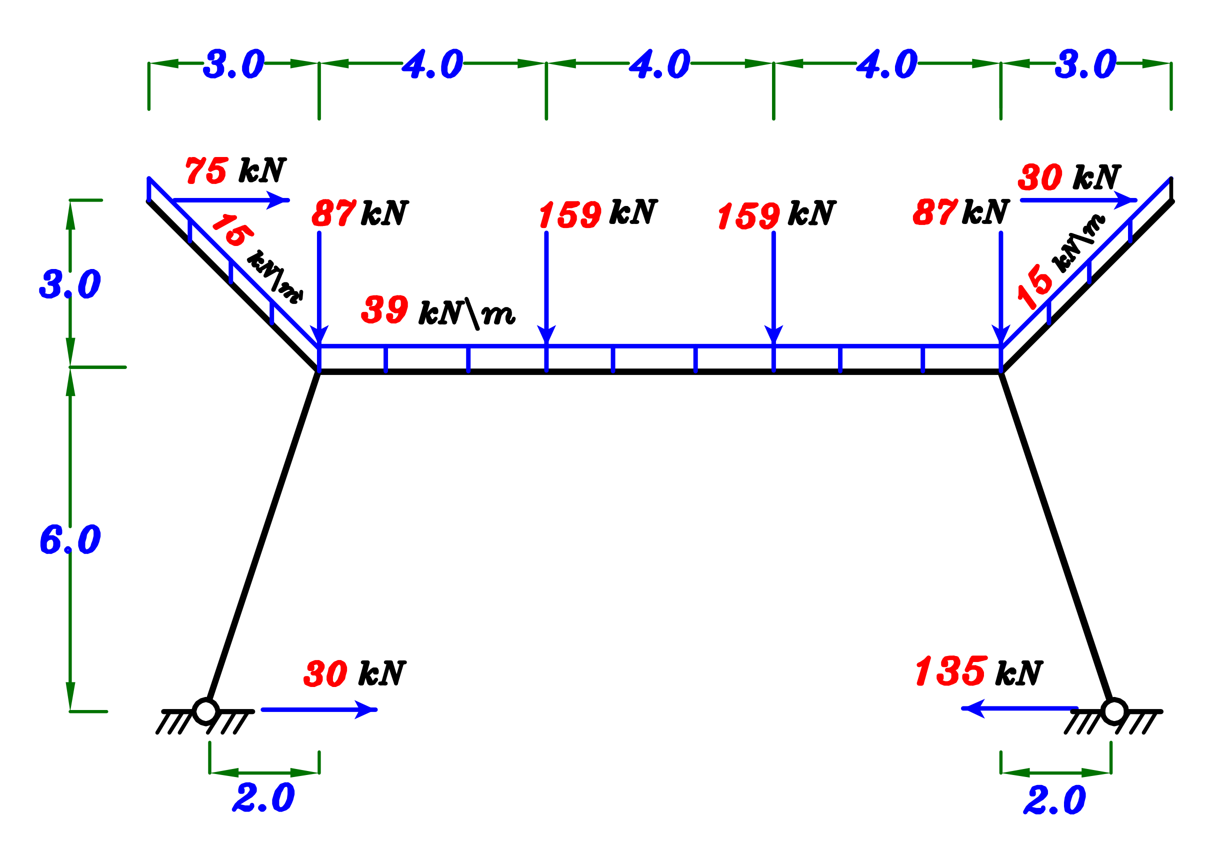




تداخل
تداخل
8
6
6
4
10
8
n = 6


5
4
Ld
5
4
4
5
5
4
4
4
4

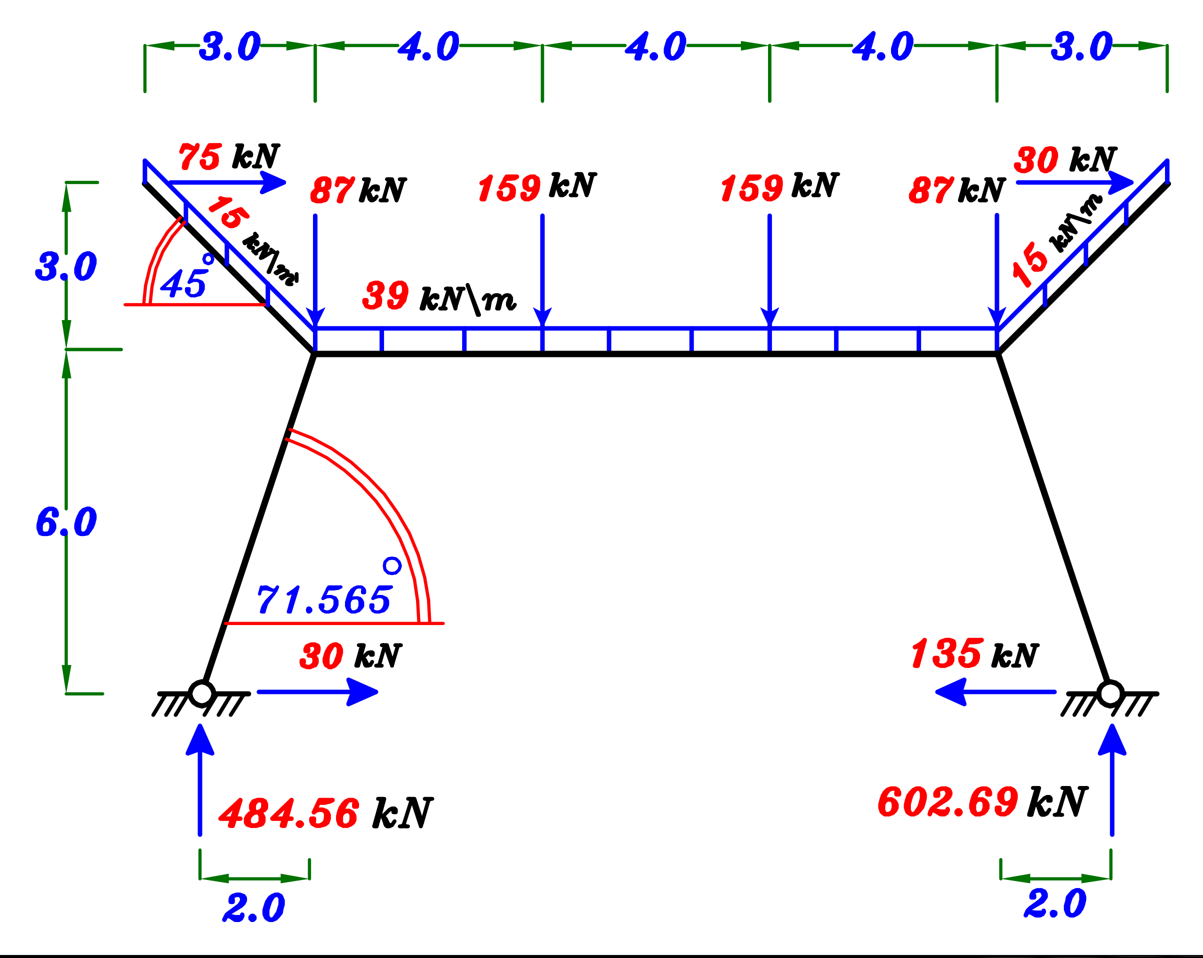
Example.

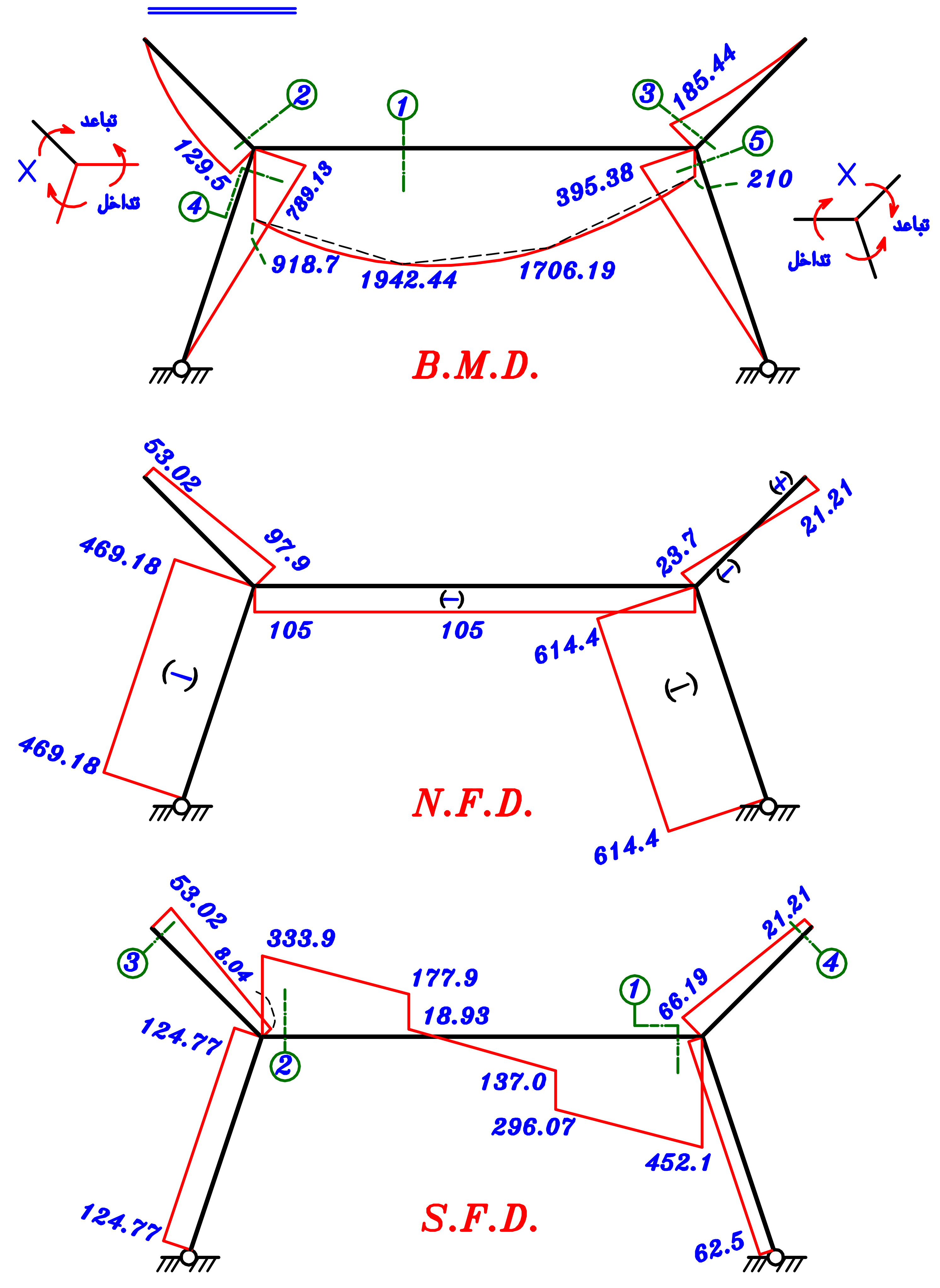


① Calculate the Reactions & Draw Internal Forces Diagrams.

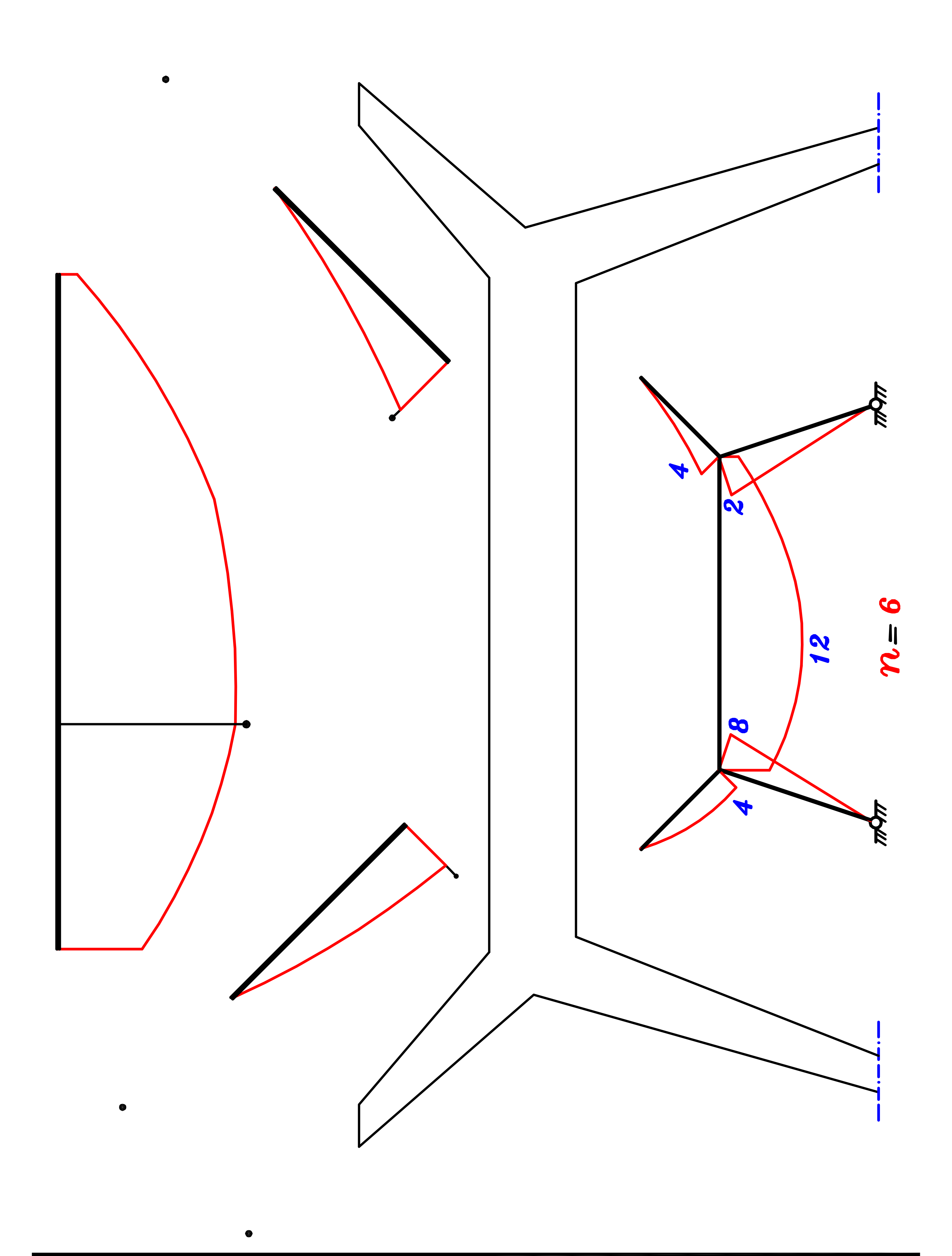
② Determine the critical sections in Bending & Shear For the Frame.

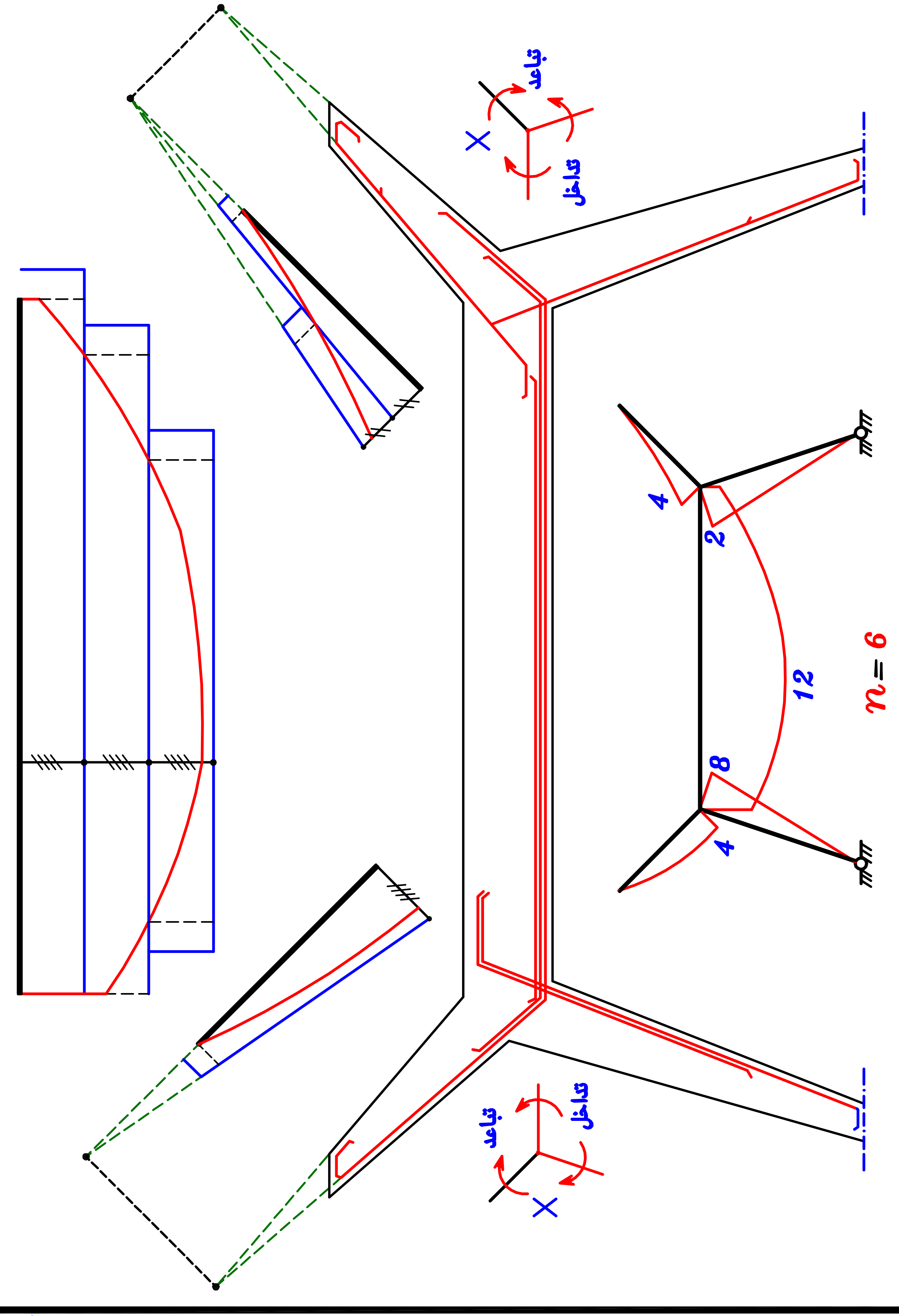
③ Draw Main RFT. only , making curtailment of steel using Moment of Resistance.



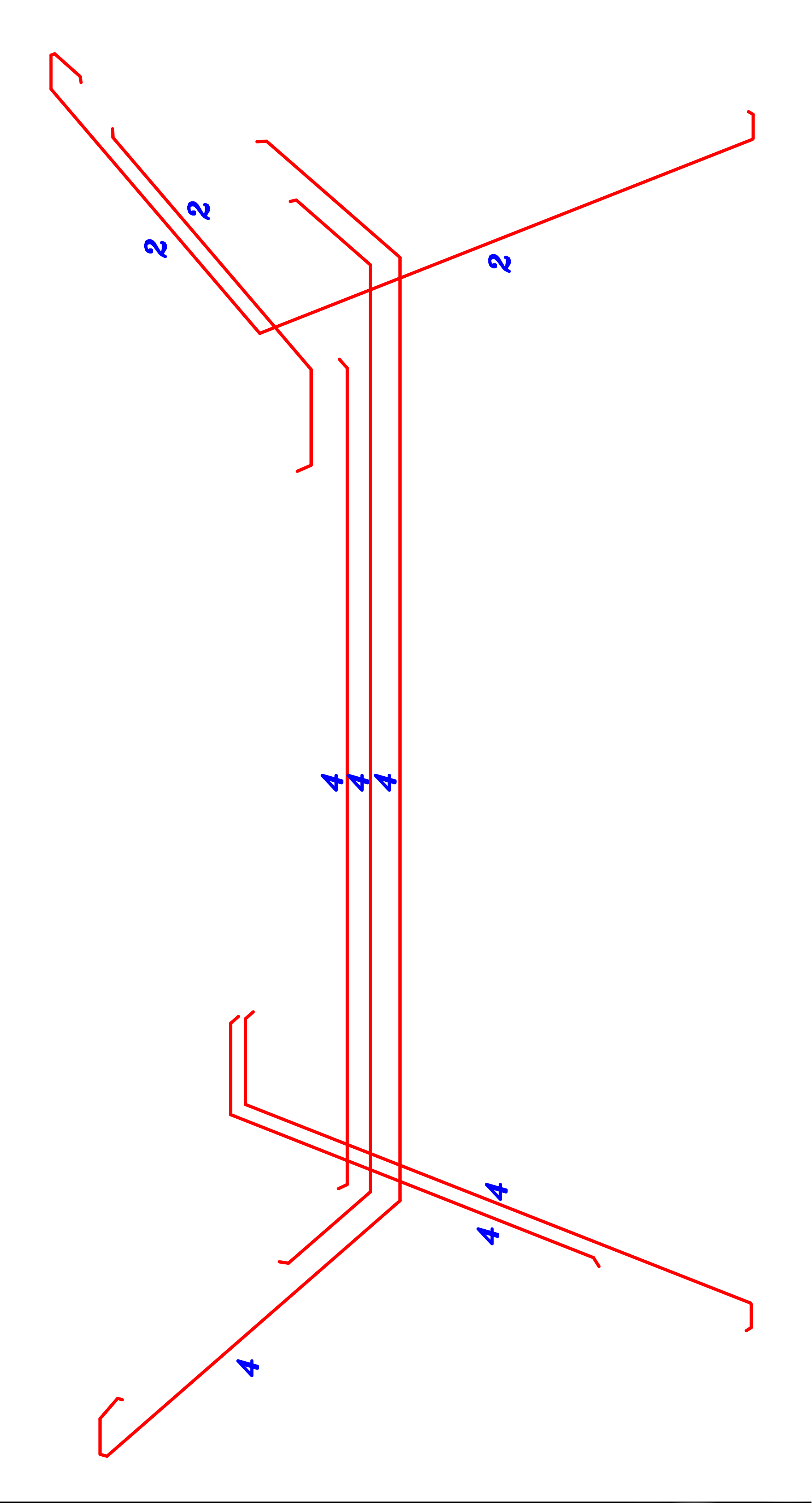


I.F.Ds
B.M.D.
129.5
789.13
918.7
1942.44
1706.19
395.38
185.44
210
تباعد
تداخل
N.F.D.
53.02
97.9
469.18
469.18
105
105
614.4
614.4
23.7
21.21
S.F.D.
53.02
8.04
333.9
177.9
18.93
137.0
296.07
452.1
124.77
124.77
66.19
21.21
62.5


4
2
12
8
4
n = 6



تباعد
تداخل
تباعد
تداخل
4
2
12
8
4
n = 6


2
2
2
4
4
4
4
4
4

Example.

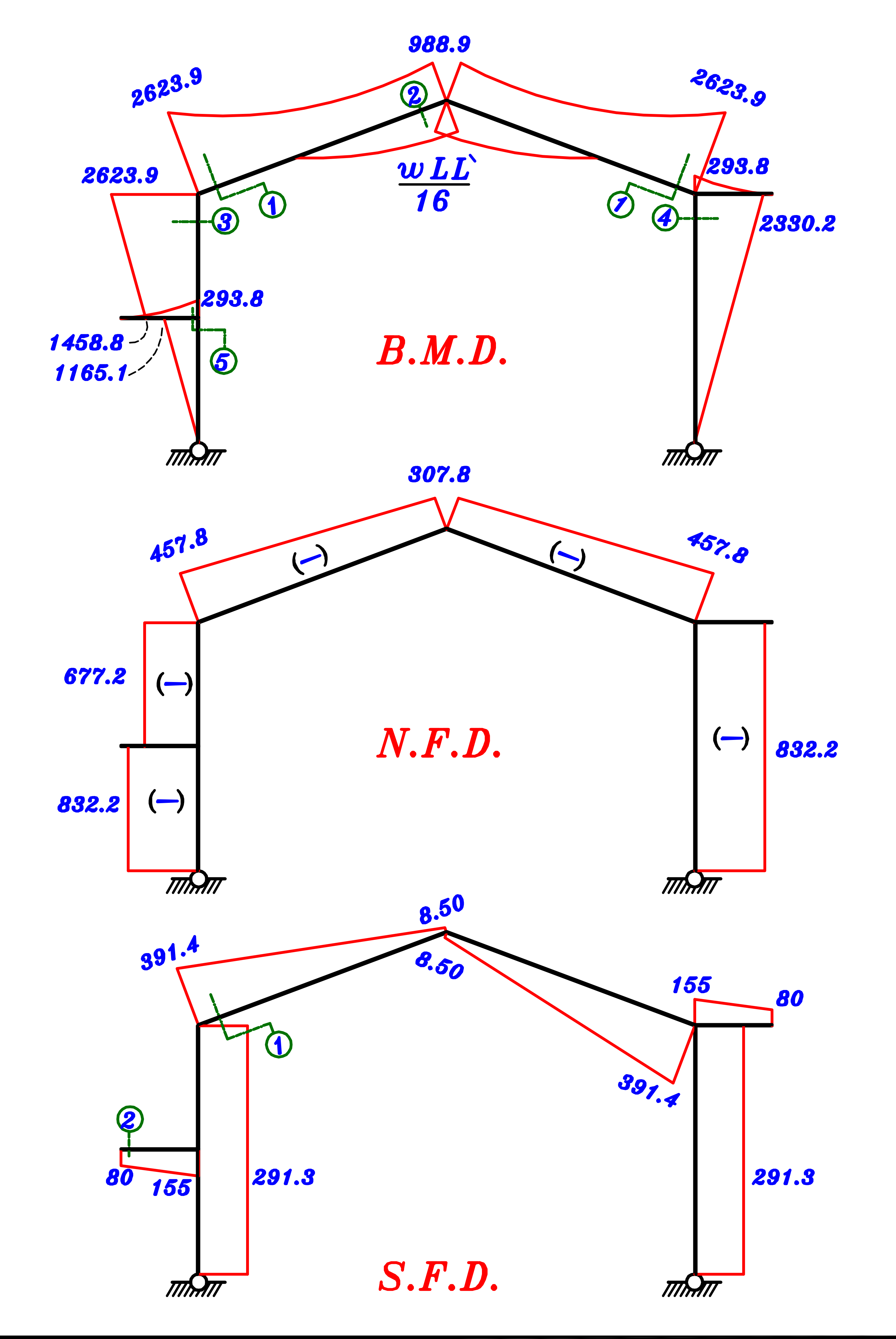
200 kN
150 kN
50 kN\m
50 kN\m
150 kN
80 kN
30 kN\m
3.0
4.0
80 kN
30 kN\m
4.0
$X_1 = 0.35\,Y_1$
Y_1
Y_2
2.5 8.0 8.0 2.5

① Calculate the Reactions & Draw Internal Forces Diagrams.

② Determine the critical sections in Bending & Shear For the Frame.

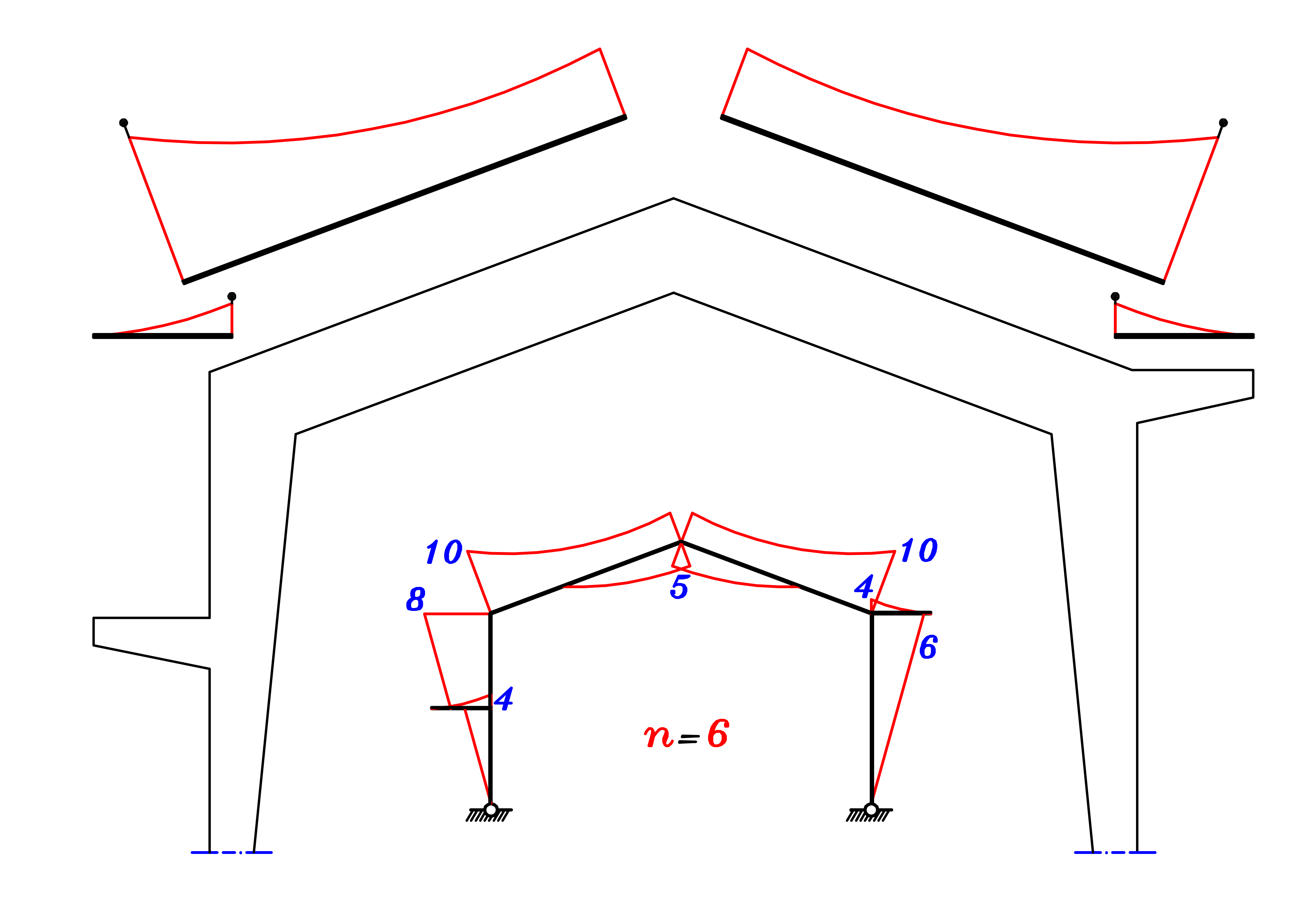
③ Draw Main RFT. only , making curtailment of steel using Moment of Resistance.

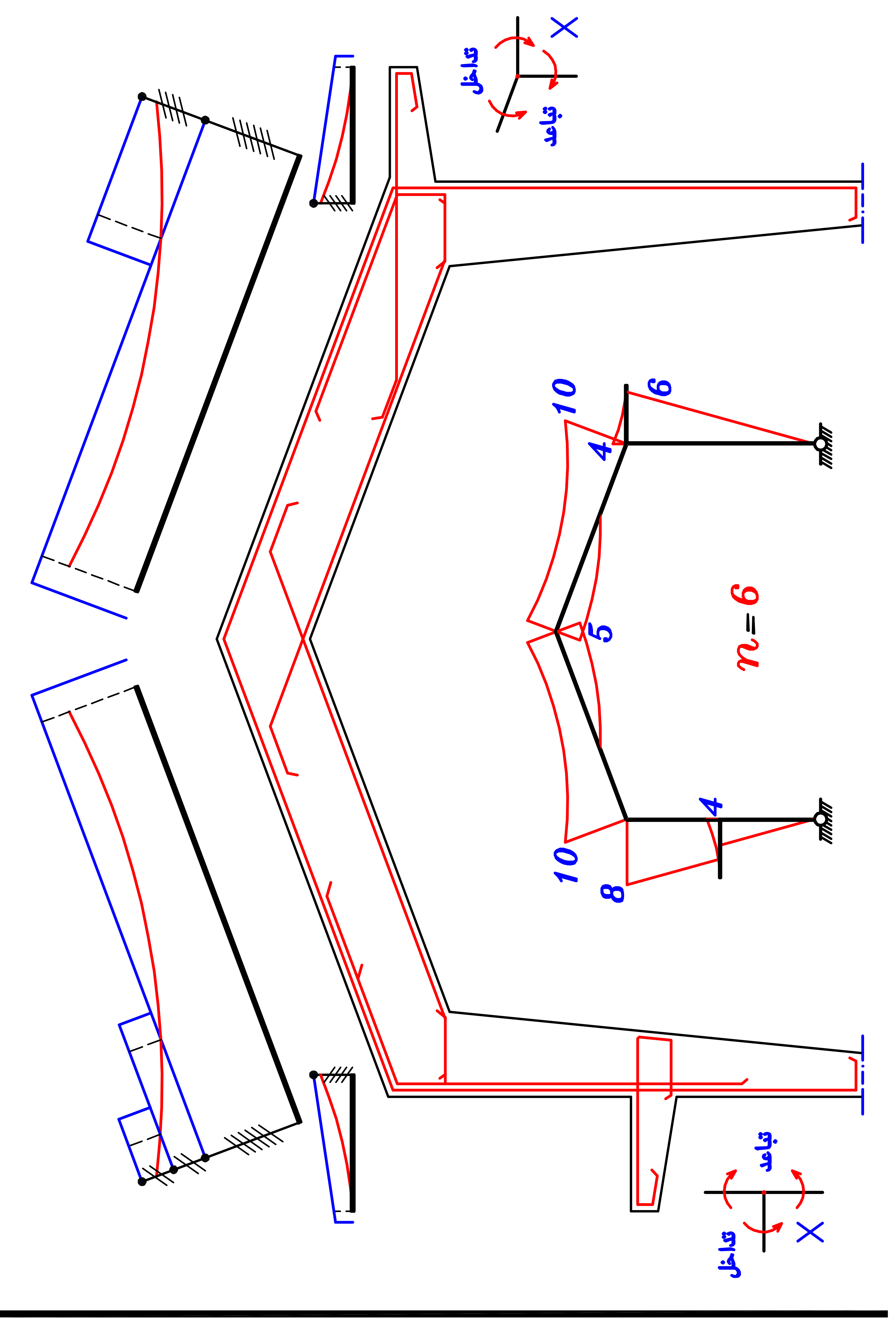
200 kN
150 kN
50 kN\m
50 kN\m
150 kN
80 kN
30 kN\m
3.0
4.0
80 kN
30 kN\m
4.0
$X_1 = 291.27$ kN
291.27 kN
$Y_1 = 832.2$ kN
$Y_2 = 832.2$ kN
2.5 8.0 8.0 2.5



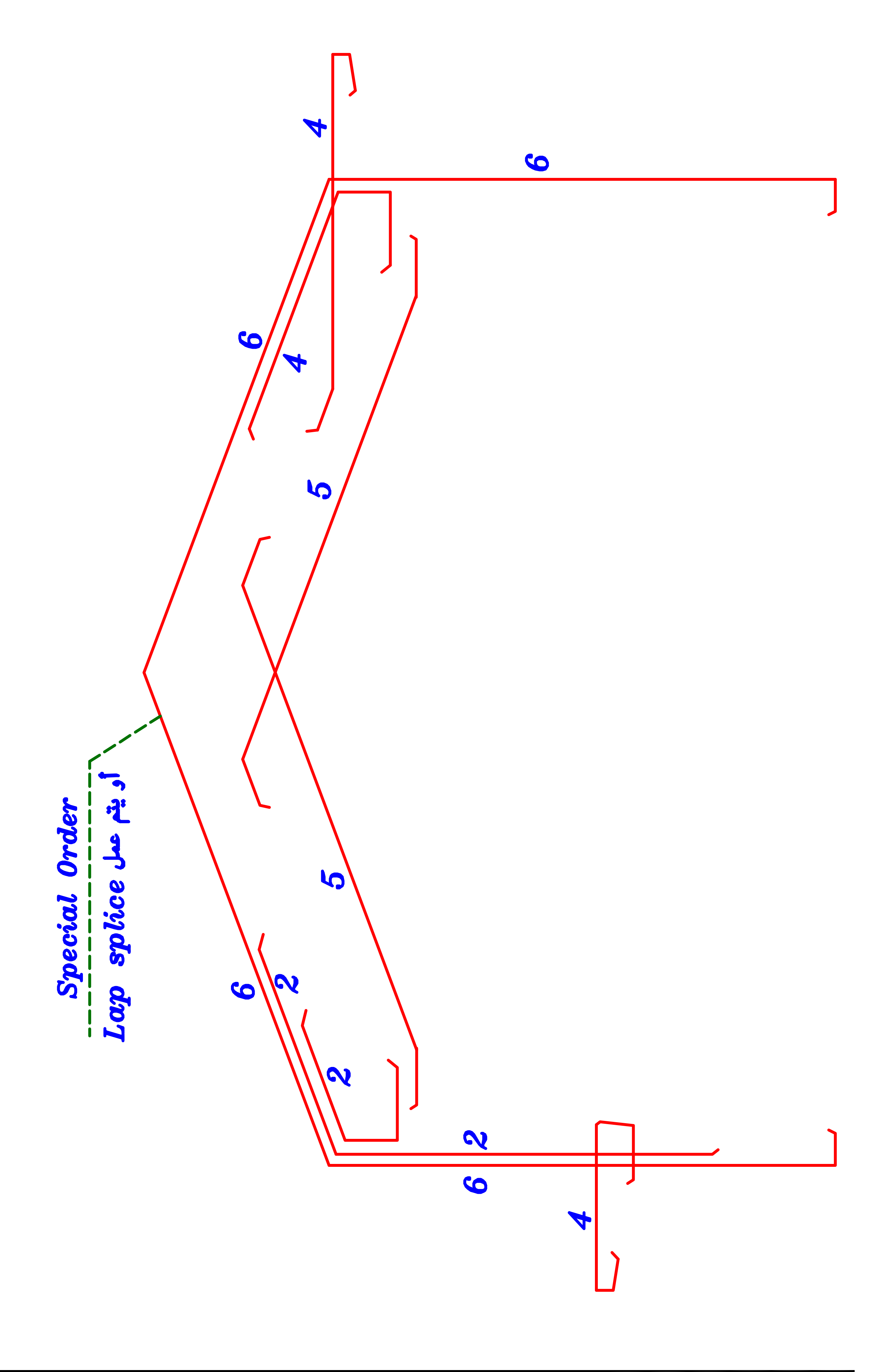
988.9
2623.9
2623.9
2623.9
293.8
2330.2
$\frac{wLL'}{16}$
1
2
3
4
5
293.8
1458.8
1165.1
B.M.D.
307.8
457.8
457.8
677.2
832.2
832.2
(–)
N.F.D.
8.50
8.50
391.4
391.4
155
80
80
155
291.3
291.3
S.F.D.

③ Draw Main RFT. & Blocks of moment of Resistance.



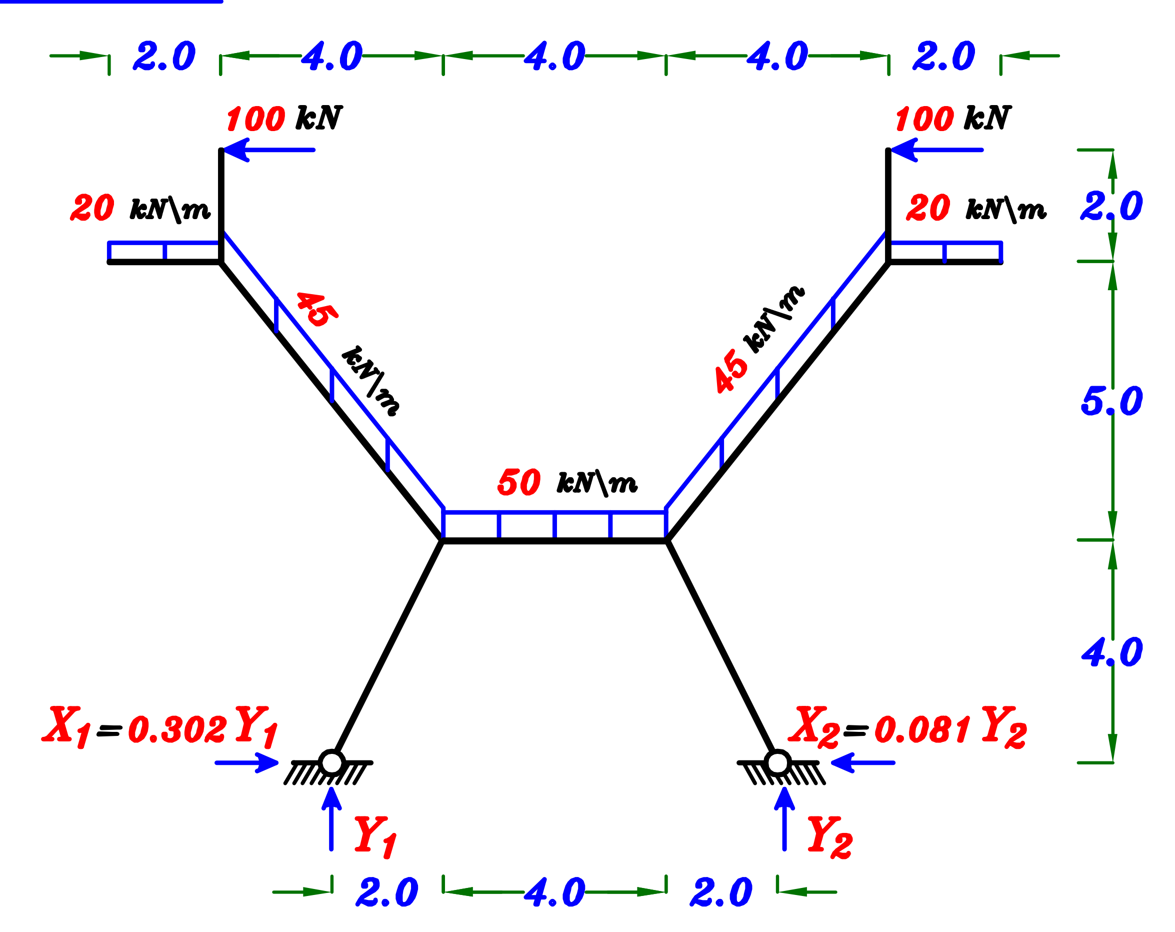


تداخل
تباعد
10
6
4
5
4
10
8
$n = 6$
تداخل
تباعد



Special Order
Lap splice أو يتم عمل
4
6
6
4
5
5
6
2
2
2
6
4

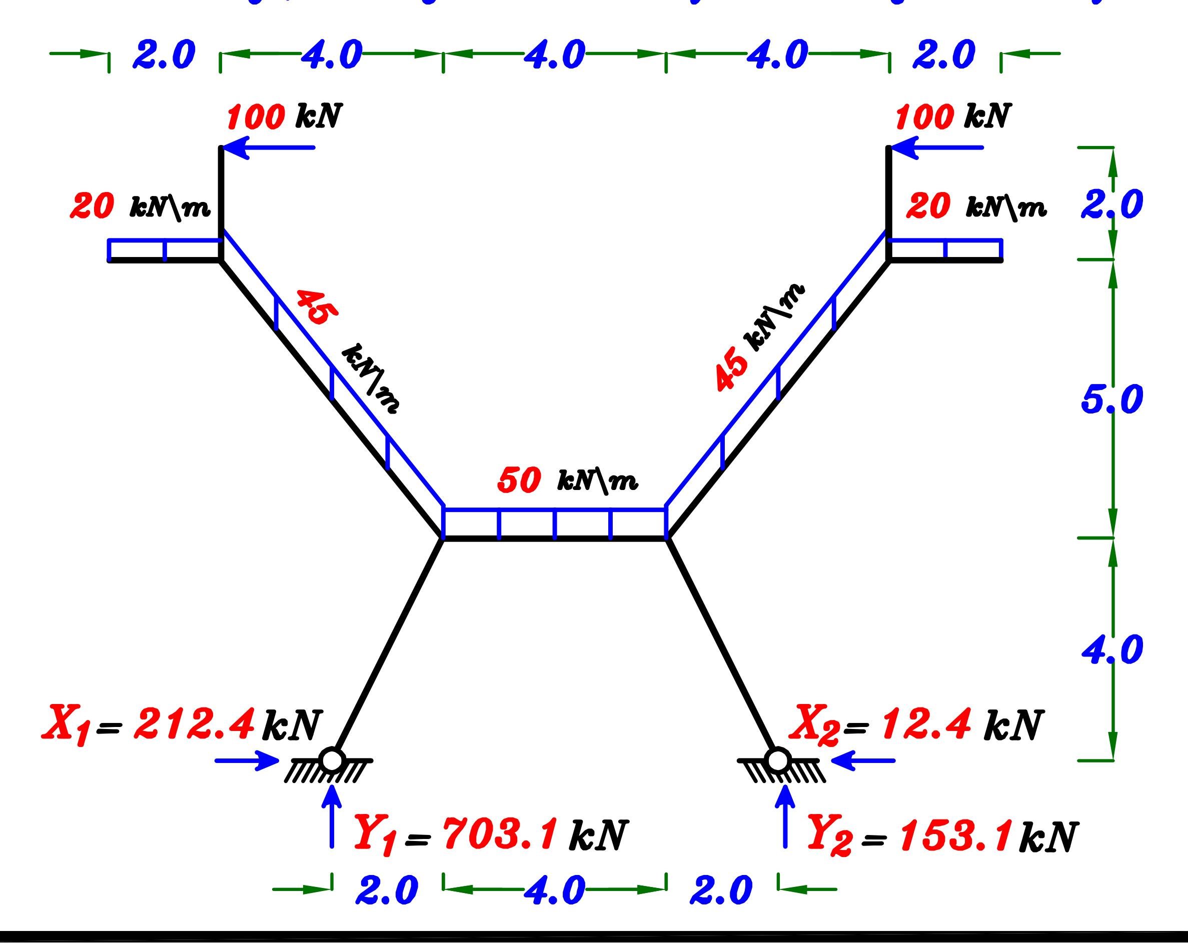
Example.

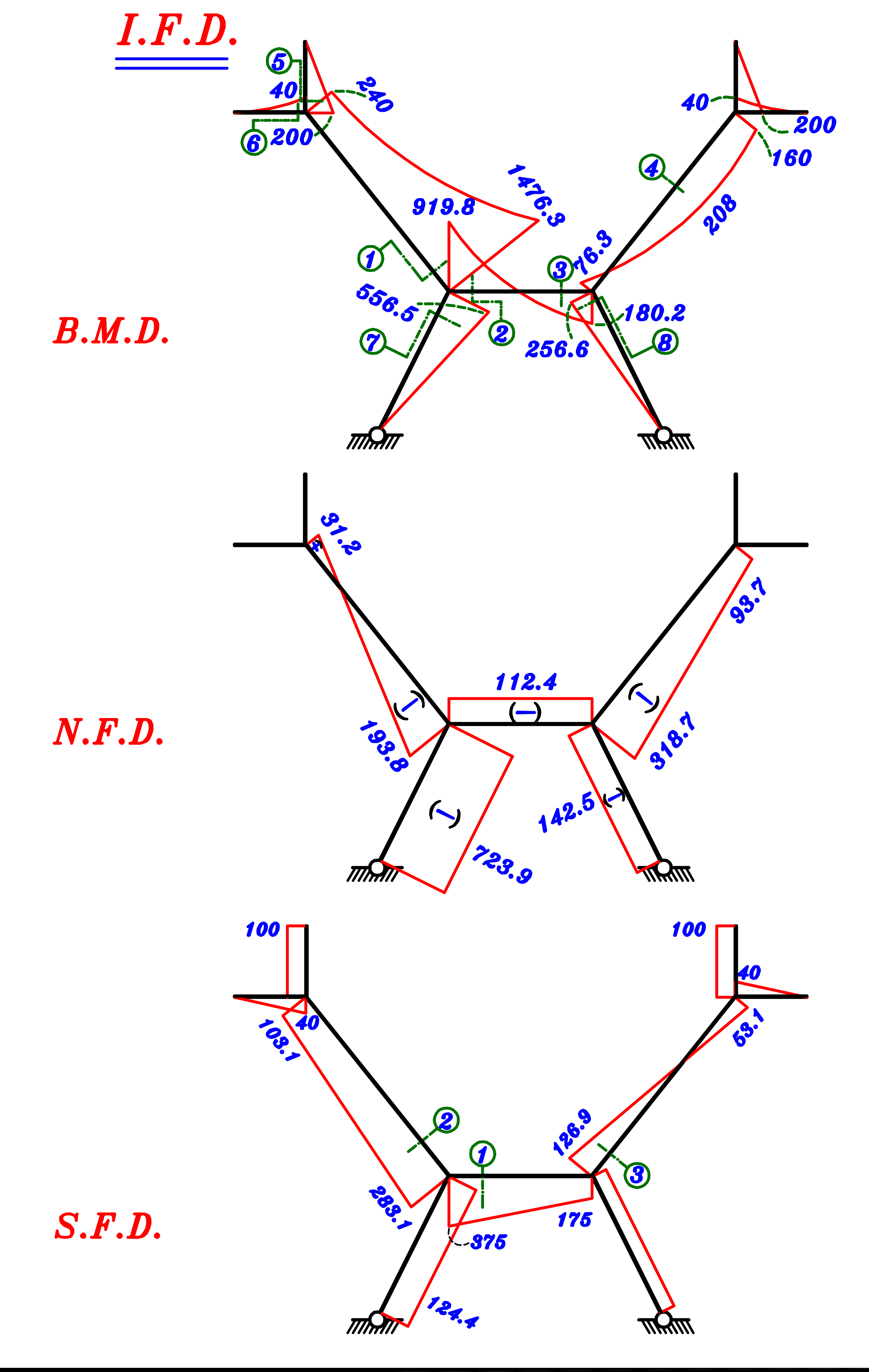


① Calculate the Reactions & Draw Internal Forces Diagrams.

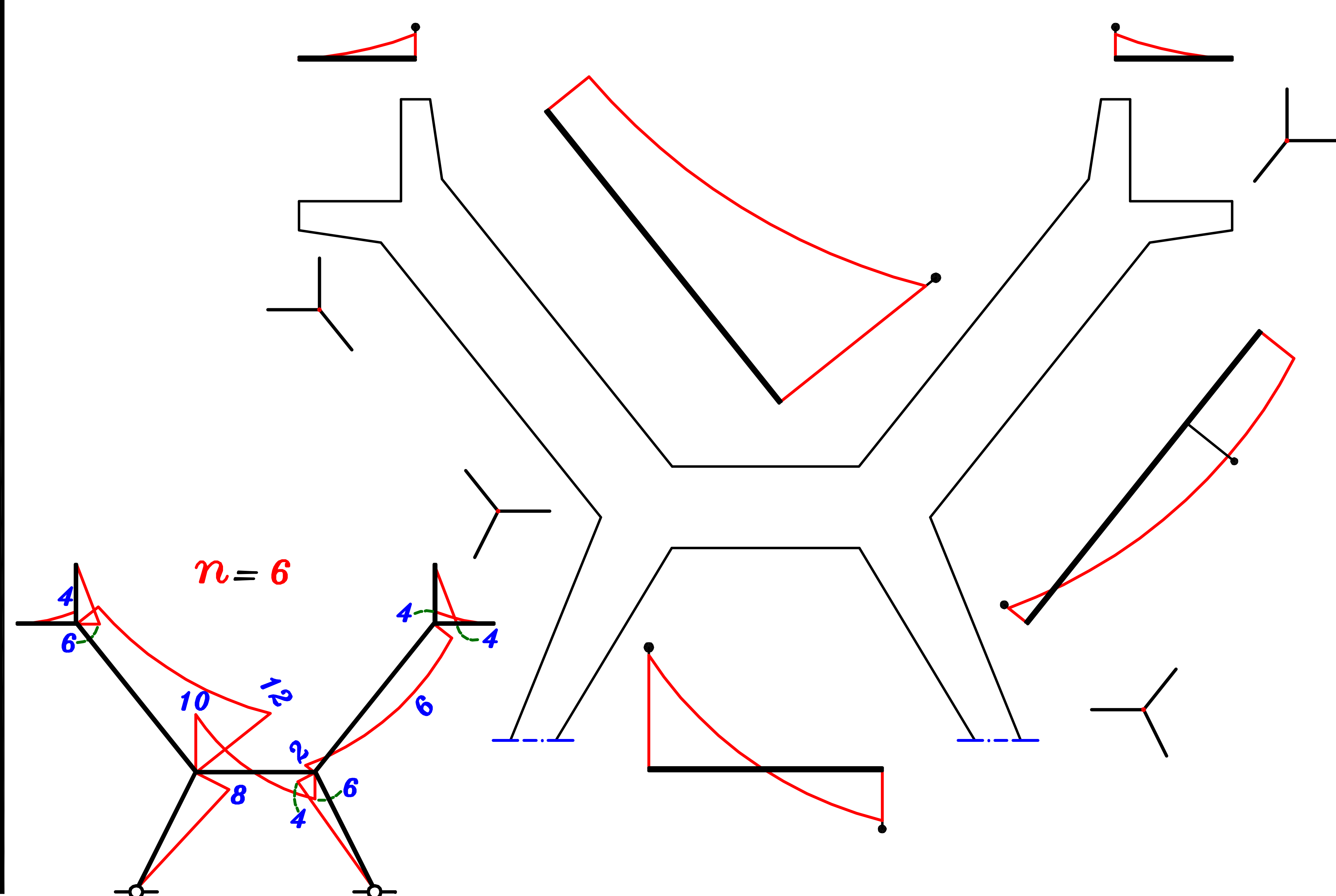
② Determine the critical sections in Bending & Shear For the Frame.

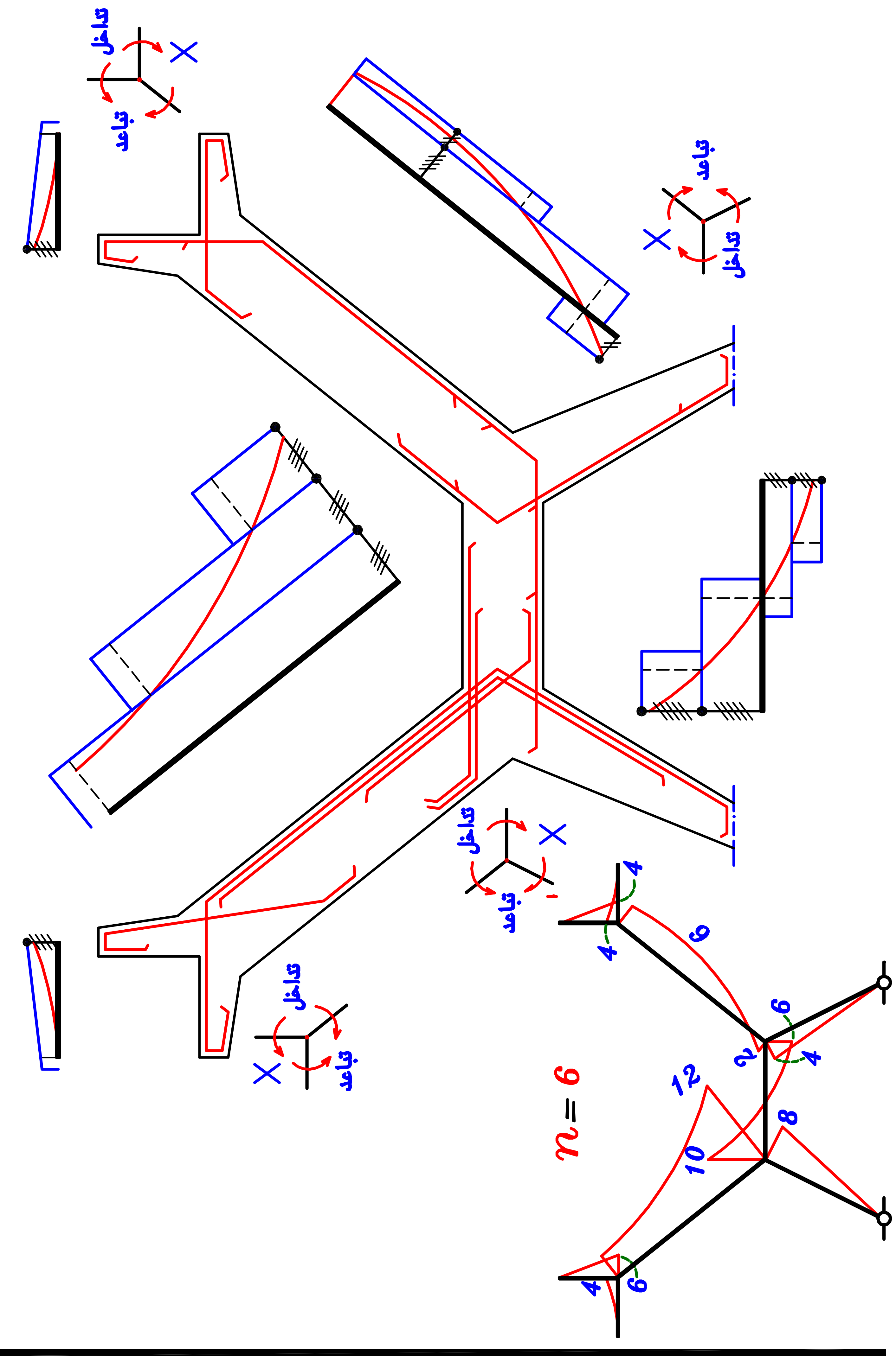
③ Draw Main RFT. only , making curtailment of steel using Moment of Resistance.



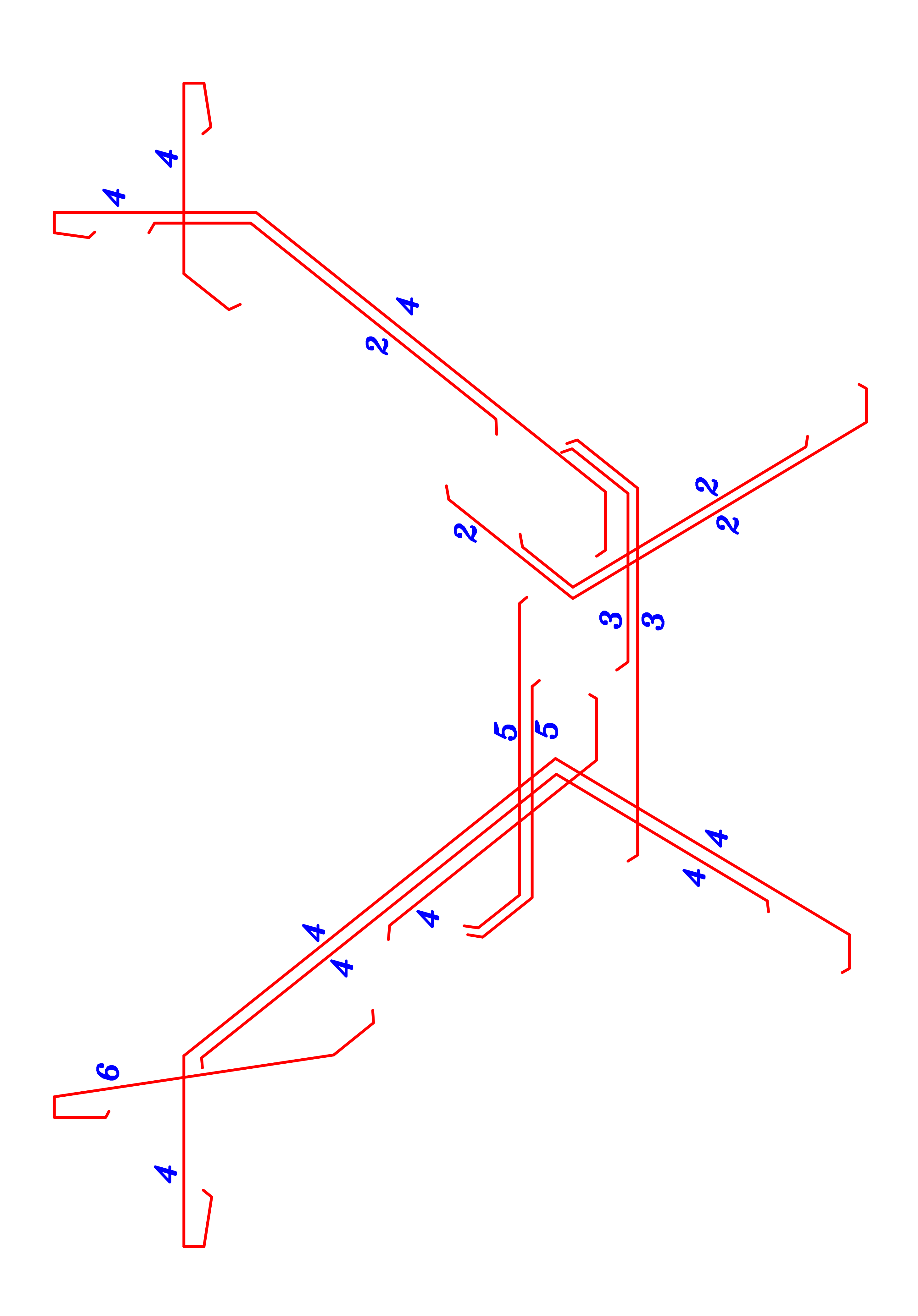

I.F.D.
B.M.D.
5
40
240
6
200
40
200
160
4
1476.3
208
919.8
1
3
76.3
556.5
2
180.2
7
256.6
8
N.F.D.
31.2
93.7
112.4
193.8
318.7
142.5
723.9
S.F.D.
100
100
40
40
103.1
53.1
2
1
126.9
3
283.1
175
375
124.4

③ Draw Main RFT. & Blocks of moment of Resistance.

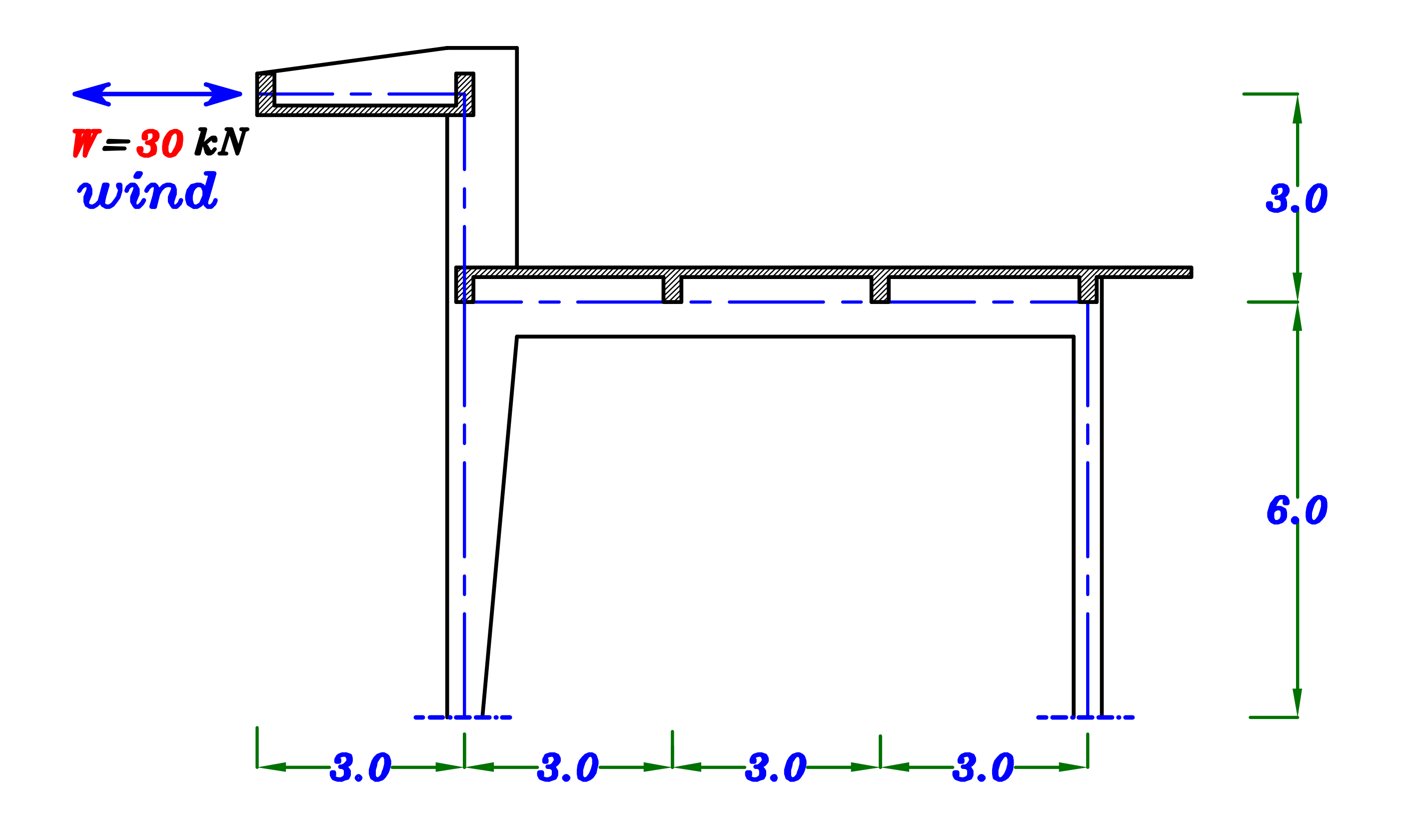




تداخل
تباعد
تباعد
تداخل
تداخل
تباعد
تداخل
تباعد
4
4
6
6
4
2
12
8
10
4
6
n = 6


4
4
4
2
2
2
2
3
3
5
5
4
4
4
4
4
6
4

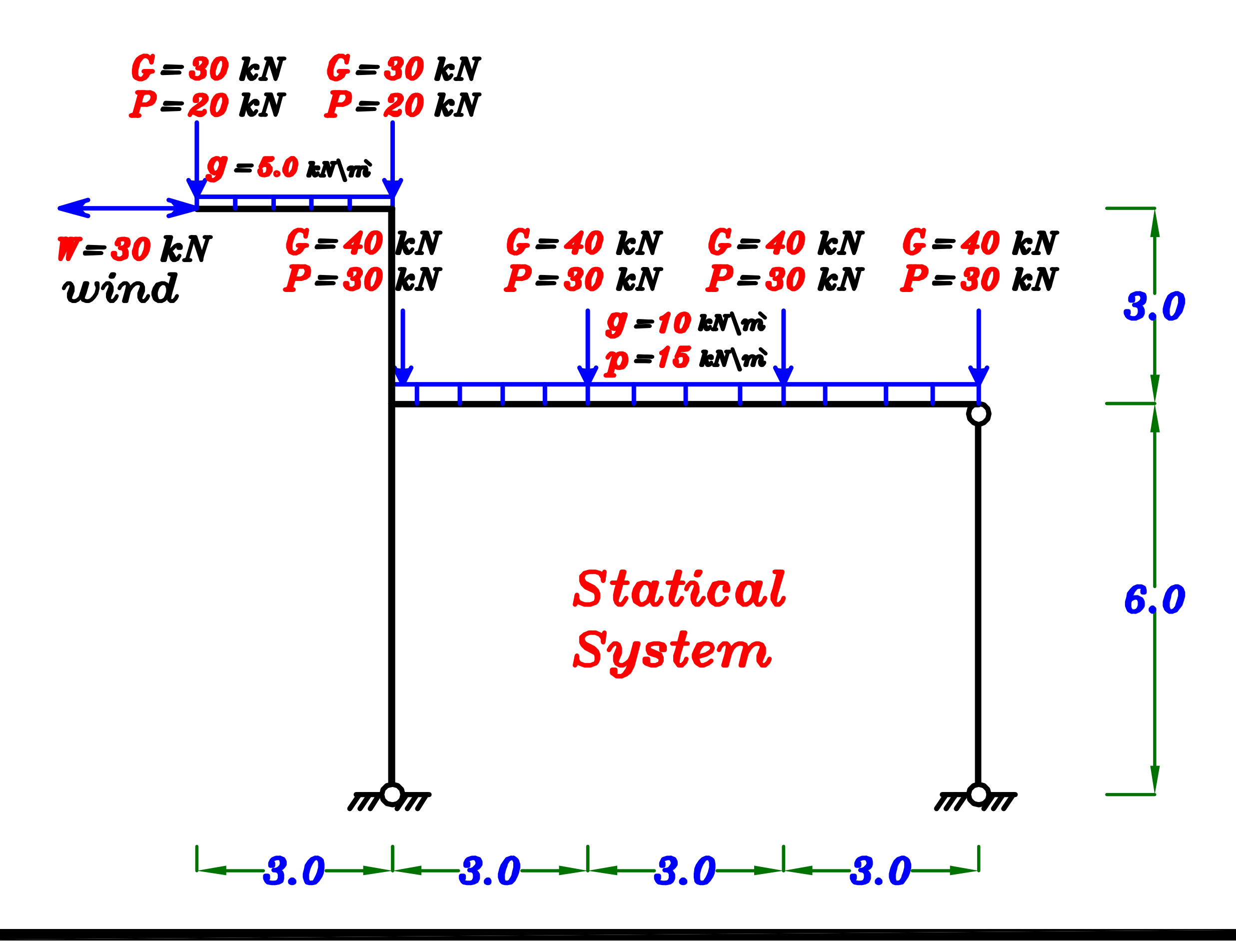
Example.

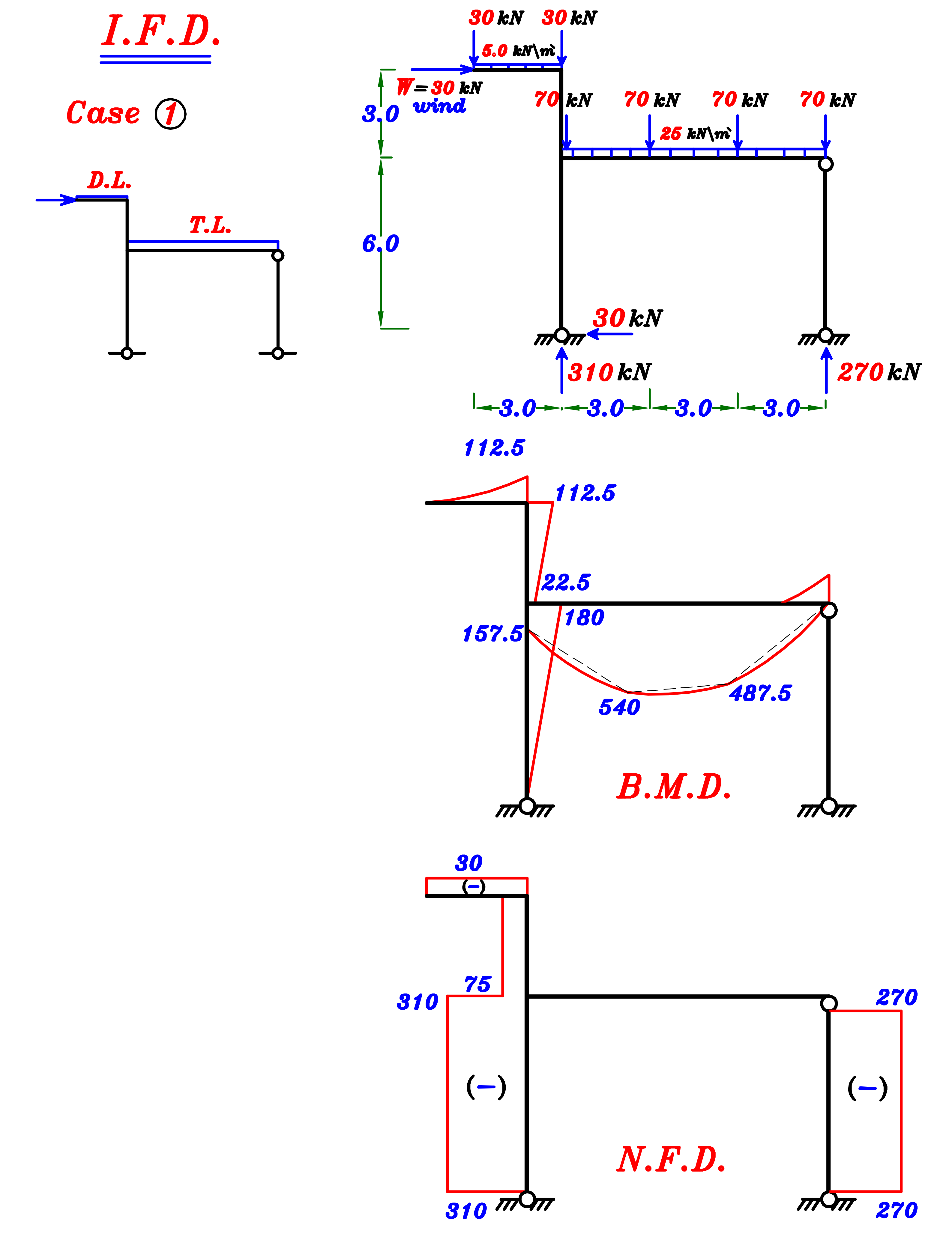


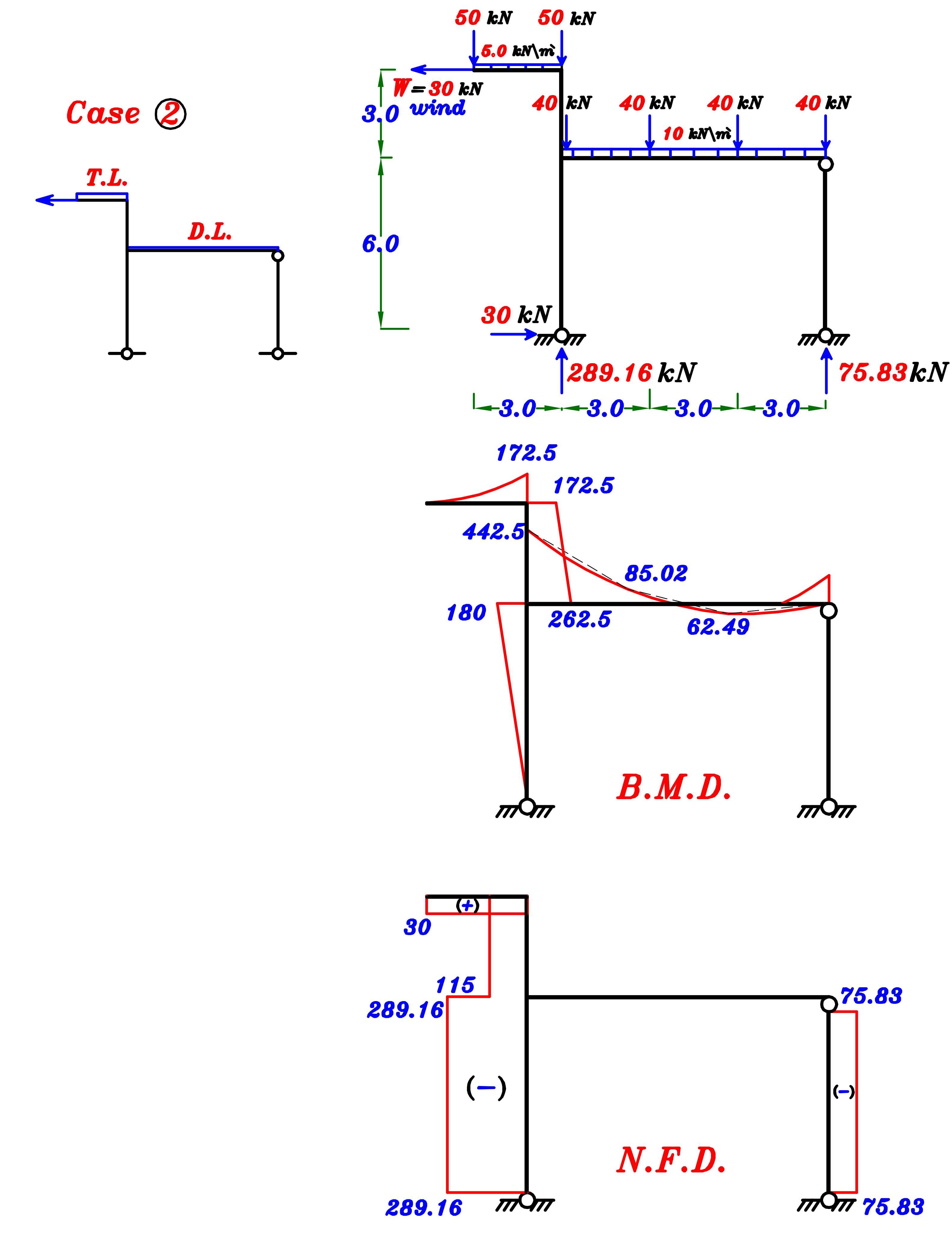
① Draw Internal Forces Diagrams. (max–max B.M.D.)

② Determine the critical sections in Bending & Shear For the Frame.

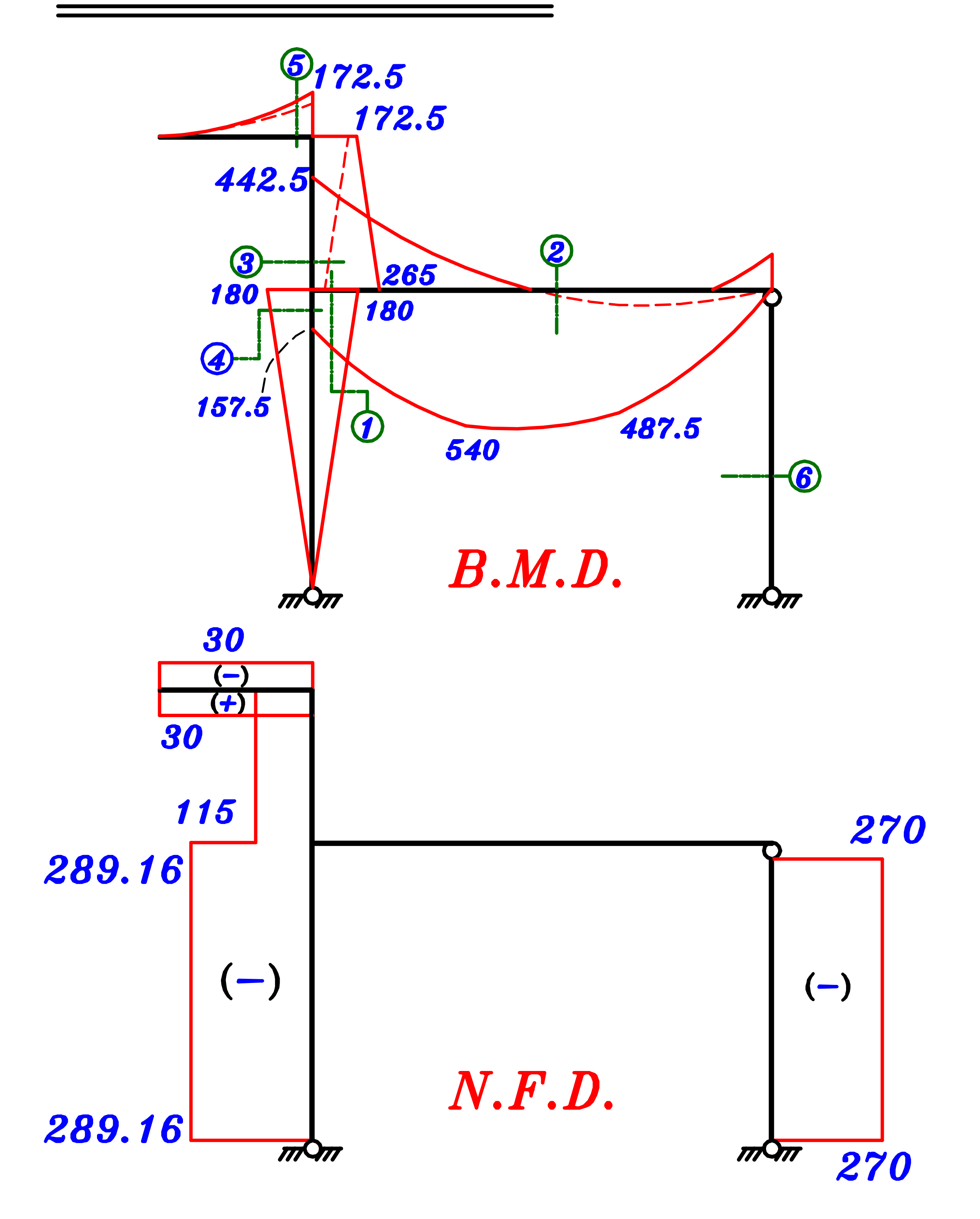
③ Draw Main RFT. only , making curtailment of steel using Moment of Resistance.




I.F.D.
Case 1
D.L.
T.L.
30 kN
30 kN
5.0 kN\m`
W = 30 kN
wind
3.0
6.0
70 kN
70 kN
70 kN
70 kN
25 kN\m`
30 kN
310 kN
270 kN
3.0
3.0
3.0
3.0
112.5
112.5
22.5
180
157.5
540
487.5
B.M.D.
30
(−)
75
310
270
(−)
(−)
N.F.D.
310
270


Case ②
T.L.
D.L.
50 kN
50 kN
5.0 kN\m`
W=30 kN
wind
3.0
6.0
40 kN
40 kN
40 kN
40 kN
10 kN\m`
30 kN
289.16 kN
75.83 kN
3.0
3.0
3.0
3.0
172.5
172.5
442.5
85.02
180
262.5
62.49
B.M.D.
(+)
30
115
289.16
75.83
(−)
(−)
N.F.D.
289.16
75.83

max–max B.M.D.

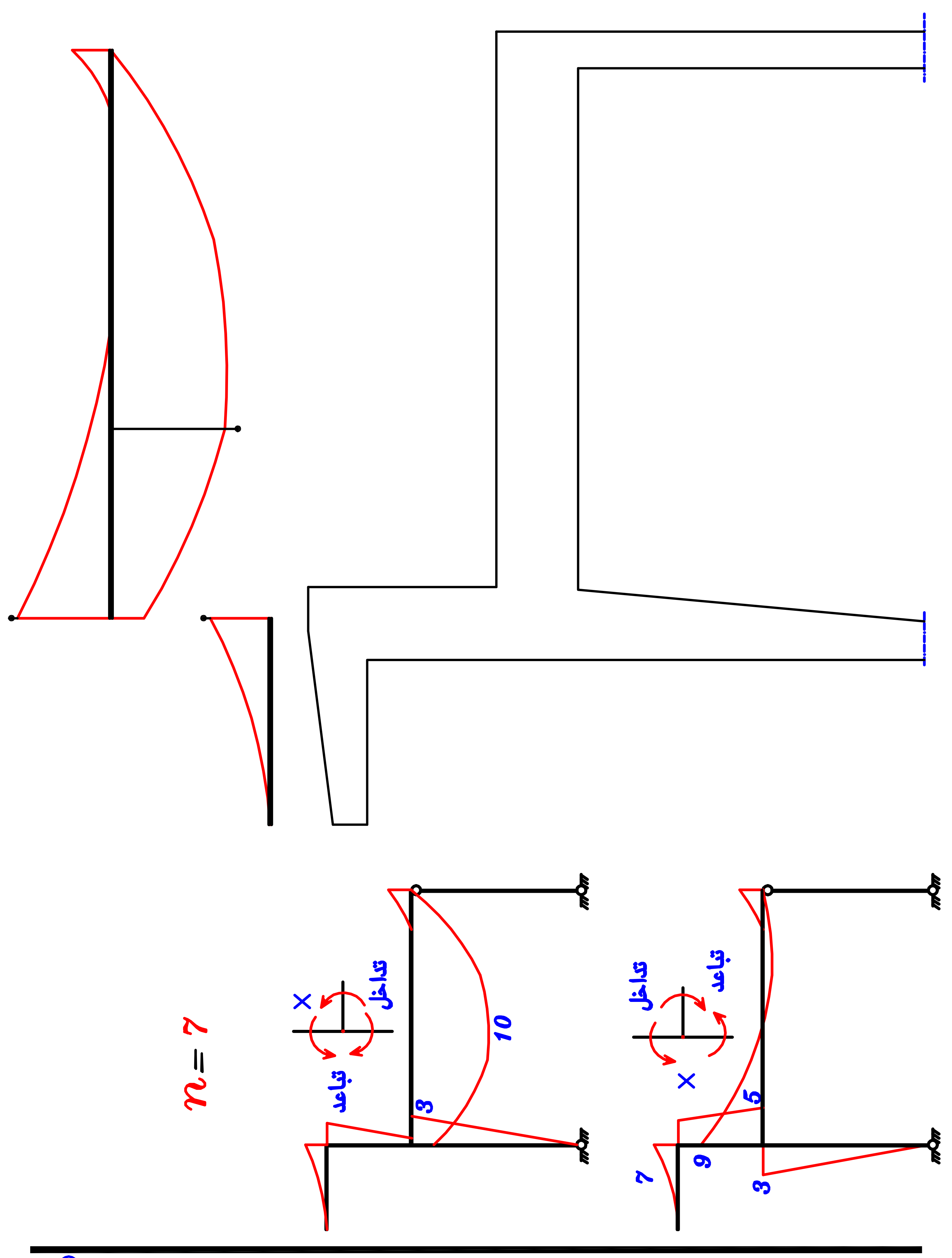


ملحوظه هامه

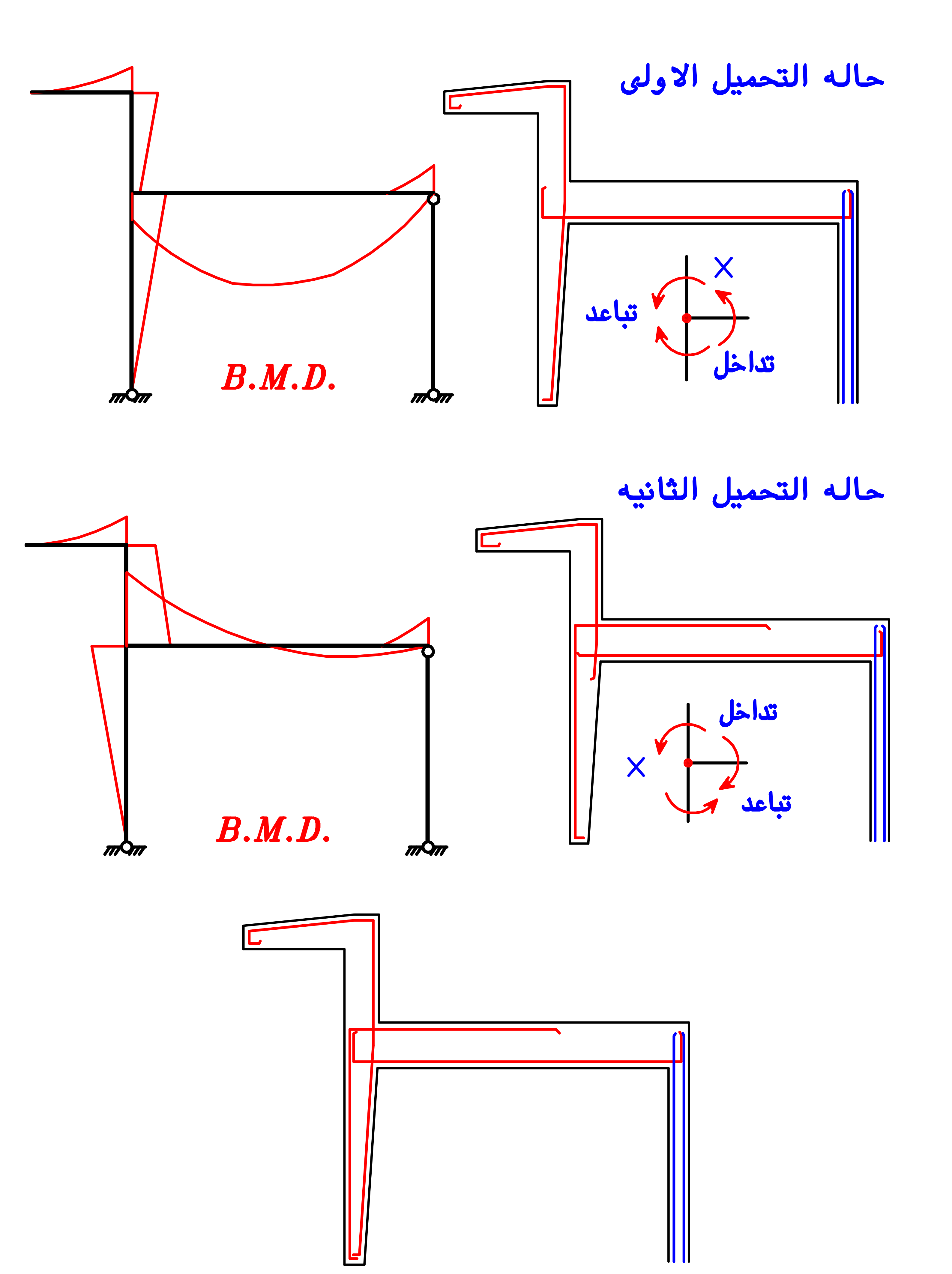
نرسم **max–max B.M.D.** فقط لتحديد أماكن الـ **Critical sections**

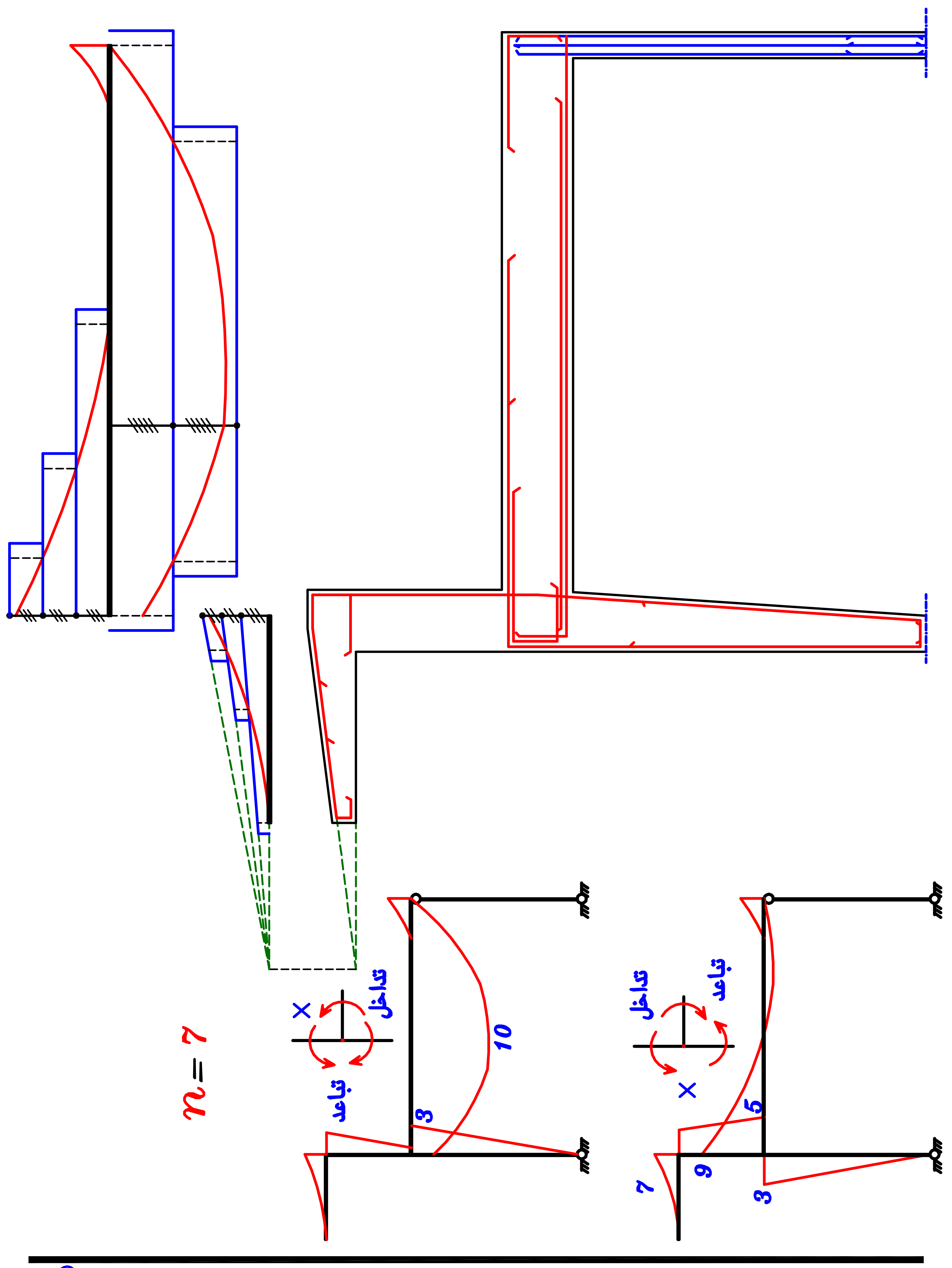
و ليس لتسليح الـ **Frame**

و لكن لتسليح الـ **Frame** نسلح على أى حاله تحميل أولا ثم نكمل باقى التسليح على حاله التحميل الاخرى .

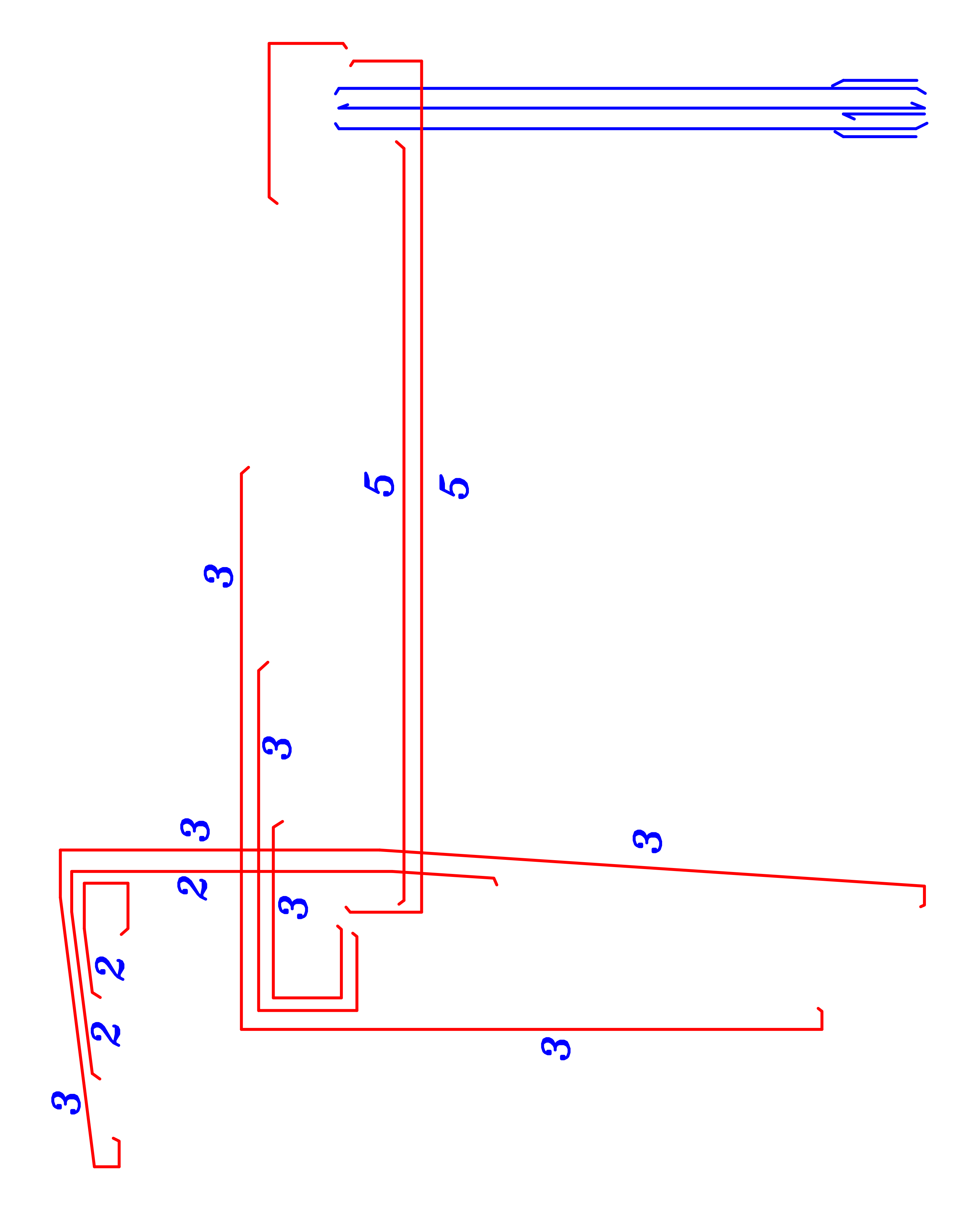


n = 7
10
3
5
9
7
3
تداخل
تباعد
تداخل
تباعد
X
X


حاله التحميل الاولى
B.M.D.
تباعد
تداخل
حاله التحميل الثانيه
B.M.D.
تداخل
تباعد



n = 7
تباعد
تداخل
10
3
5
9
7
3


5
5
3
3
3
3
2
3
2
2
3
3